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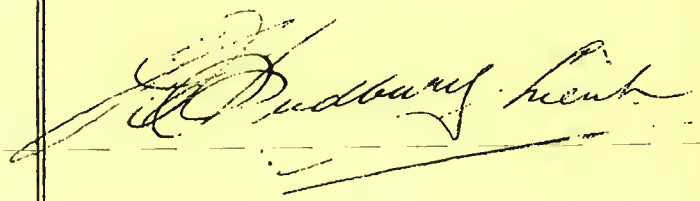
AUSTRALIAN IMPERIAL FORCE

GRENADES
AND THEIR USES

:: Issued by instruction of the ::
Chief of General Staff, Australia.

Compiled by
Lieut.-Col. R. LAW,
Australian Engineers.



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MEMORANDUM ON THE TRAINING AND EMPLOYMENT OF GRENADIERS.

ISSUED BY THE GENERAL STAFF AT GENERAL HEAD-QUARTERS.

1. *The Objects of Grenade Throwing.*—Among the more important purposes for which grenade throwing may be used are the following:—

(i) To prevent the approach of enemy's sap heads towards our own trenches.

(ii) To facilitate the progress of a storming party along the enemy's trenches which have been successfully attacked.

(iii) To prevent the advance of the enemy along our trenches which they may have succeeded in entering.

2. *Selection of Men.*—The men taken for training as grenadiers should be selected from the very best, bravest, and steadiest in emergency.

3. *Training and Instruction.*—Training and instruction must be progressive, and should commence with practice in throwing dummy grenades. This should always be carried out with the strictest observance of active service conditions, viz.:—

(*a*) The men must be fully armed and equipped.

(*b*) Throwing must be invariably practised from a narrow trench or behind a barricade.

(*c*) Men should be practised, not merely to throw over a traverse, but at least into the space beyond the second traverse from them.

(*d*) For practice, traverses should be made at varying intervals, and some should be loopholed, in order to teach men that they may be checked by, and that they may have to resort to, rifle fire.

(*e*) Men must be taught to throw accurately at both long and short distances.

The best results for long distance throwing are obtained by swinging the arm upwards and slightly forward, the hand, at the commencement of the swing, being about the level of the waist. For short distances, the grenades should be lobbed from the shoulder by an action similar to that employed in "putting the weight."

(*f*) Men should be taught to concentrate or distribute fire as required.

4. *Practice with Live Grenades.*—Training in grenade throwing should be carried out in each battalion under a selected officer, but all officers should make themselves acquainted with grenade tactics.

Before men are allowed to use live grenades, the following should be explained and demonstrated:—

(*a*) The construction and action of the hand grenade.

(*b*) The properties of fuses, detonators, and explosives.

(*c*) The making up and firing small charges to accustom men in handling explosives, cutting fuses, &c.

Plenty of practice with live bombs is essential, but familiarity with explosives must not be allowed to induce carelessness in handling them.

The length of fuse at first should be such as to allow at least ten seconds' burning. This length should be gradually reduced to the service length as the men gain confidence and skill in lighting and throwing.

5. *The Organization of a Trench-storming Party.*—A trench-storming party will, as a rule, consist of—

(*a*) The bayonet men to cover the party.

(*b*) The grenadiers. Each grenadier should, as a rule, be accompanied by a carrier.

(*c*) The remaining carriers. This party should be followed by—

(*d*) The sand-bag men, who carry sand-bags half filled. They block side entrances to the trench, and finally barricade the furthest point reached in it. In an attack the sand-bag men may form part of the main body, or, in working along a trench, be taken from the men detailed to modify or destroy the trenches, or to hold them.

The sand-bag men, and other parties in rear of them, will vary in numbers, but for working along a trench the grenadier party might consist of two throwers, with a reserve two behind to take their places in case of casualties; they might be followed by four carriers, if they are necessary; there should also be about eight bayonet men. Four of these last, including the N.C.O. in charge, should be just in front of the leading grenadiers and carriers, and four behind them and in front of the reserve throwers and carriers. Some of the men in rear of the leading throwers and carriers must be left to watch communication trenches that may be passed in advancing. In an attack, there should be spare grenadiers and carriers at the head of each company, who will be available to replace casualties and take over the watching of side trenches from the grenadier party.

6. *Method of Attack.*—(*a*) The following mode of action in working along an enemy's trench has been found successful:—

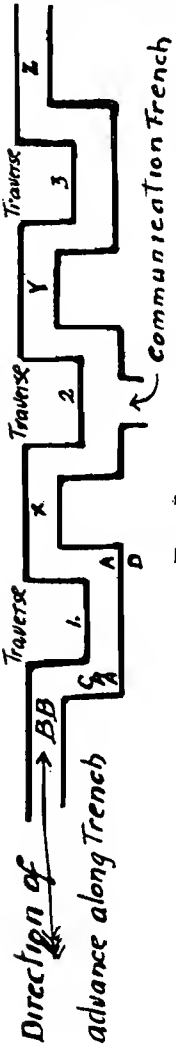


Fig. 1.

On arriving at traverse 1, the bayonet men should place themselves in position AAA, the N.C.O. at C, or as required, the grenadiers at BB, behind the traverse with the carriers, if any, and spare bayonet men behind them. No. 1 grenadier then throws a grenade over the traverse into trench X, and a second one into trench Y. The leading bayonet man can then move forward, so as to see into trench X. If it is clear, he passes back word, and the three bayonet men move up trench X and occupy positions at traverse 2, similar to those at traverse 1. The grenadiers then follow, and throw grenades into Y and Z. Until Y is clear, the reserve bayonet men remain behind traverse 1, in case the enemy should throw grenades into trench X.

Should trench Y be too far to reach from traverse 1, the grenadiers should move to point D and throw obliquely into it before advancing to traverse 2.

(*b*) When a machine-gun detachment accompanies the party, the following method has been found to be effective:—The officer decides on a suitable position for the gun as soon as the hostile trench is reached; the machine-gun detachment then construct an emplacement blocking the trench, but leaving room for one man to pass at a time.

The grenadiers act as described in (*a*), and a forward stop at least 40 yards in front of the gun emplacement is constructed, blocking the trench, and also leaving room for one man to pass at a time.

The traverses between the emplacement and the forward stop should be cut away so as to give a clear field of fire to the machine-gun.

(*c*) Should an "island traverse" be encountered the leading bayonet men must watch both sides of it whilst the grenadiers are throwing grenades.

7. *Grenade Carriers.*—Receptacles for carrying grenades have been devised. One type is in the form of a basket or box similar to the machine-gun belt box, with strap handle, and fitted inside to take the type of grenade in use.

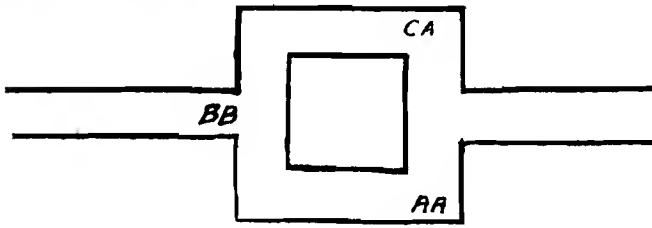


FIG. 2.

Another type is that illustrated in the sketch. It consists of a leather belt, of the bandolier type, which goes three-quarters around the body, and has pockets in front for the grenades. The belt is supported by two straps attached in front, which are passed under the shoulder straps, then through loops on ends of the belt, and then are brought round the waist and tied in front. This leaves the man free use of both hands. (Figs. 3, 4.)

8. *Sand-bag Men.*—Sand-bag men should be practised in filling sand-bags and passing them quickly along a chain of men in a trench to a given point where a

barrier is to be constructed. When a barricade is made it must be machine-gun proof, and it should have a second barrier, out of bombing distance, to check the enemy should he attempt to recover his trench by bombing.

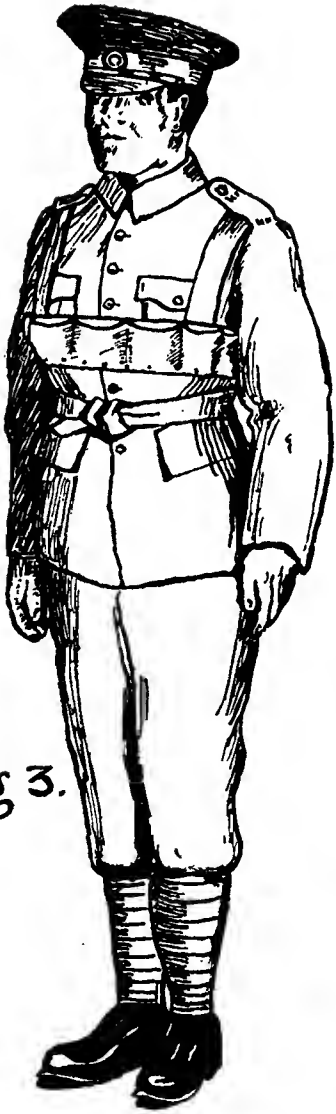


Fig 3.

FRONT VIEW.

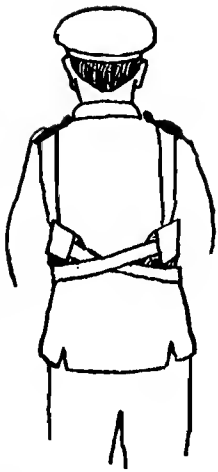


Fig 4.
BACK VIEW.

GRENADES AND THEIR USES.

SECTION 2.

Present conditions of trench or fortress warfare have revived the use of the ancient hand grenade, and grenadiers are once more to the fore. A grenade was originally a small spherical shell, about 3 inches in diameter, made of iron or annealed glass, filled with gunpowder, ignited with a fuse, and thrown by hand. Grenades are said to have been first used in the year 1594. In the years 1914-15 their use has been fully demonstrated, and, except for modifications rendered necessary by modern progress and knowledge of high explosives, the essential principles remain the same. That the use of grenades was foreseen is evidenced by the fact that a description of certain grenades is included in *Musketry Regulations, vide* p. 200, 1914. The smaller types, thrown by hand, are usually designated grenades, whilst the larger varieties, thrown or projected by mechanical means (*e.g.*, trench mortars, catapults, and spring guns) are usually referred to as bombs. In the following notes this classification will be adhered to, as it appears to the writer that some definite distinction should be made between the types alluded to. Grenades thrown by hand are intended for use against the individual, whilst bombs thrown by machines may be used against earth or other defensive works, when desirable. There are exceptions to every rule, and the grenade fired from a rifle is called a rifle grenade. The old iron ball is still used, and its qualities are difficult to surpass, but a glass ball would be quite useless with high explosives. The modern improvements include better fuses, easier means of ignition, automatic, and semi-automatic mechanical lighting devices, also segmentation of the shell or body, so that the grenades

will split up into well-defined segments. The use of modern, deadly, high explosives, makes the grenadier of to-day something equivalent to a rapidly moving field-gun firing high explosive shell of low velocity at short range.

In the early stages of the war, lack of preparation found us with an insufficient supply of grenades, and also with types which could be improved upon; conditions have altered now, and there is an ever-increasing supply of types and designs, which are second to none. With some training, our Australian troops can show that if they, in times of peace, are experts with a cricket ball, their powers in that direction are only surpassed by their ability to lob grenades into the trenches, when forced to place sport on one side and enter the deadly, but honorable, game of war.

There are many diverse types of grenade, each with its special characteristics and tactical uses, some of which are described in the pages which follow. Grenadiers should know and recognise each type, but the important part of the training is the development of the ability to lob the grenade, when and where the thrower desires it to explode, with accuracy and rapidity. It should be remembered that this can be easier learned in Australia than in face of the enemy where practice may be interrupted by his kind attentions. It rests with ourselves to put our whole-hearted energies into the training; the seat of actual war seems far off, but it is really much nearer than many of us realize—a short trip in a transport, a few days wait, and we may be at the game—but, it is hoped, not without that confidence which is inspired with knowledge of our own powers, the result of diligent preparation.

Grenades should never be transported with detonators in position, it is far too dangerous; all grenades should have means of inserting the detonator at the last possible moment. Grenades with a friction-lighting arrangement are dangerous unless this can be inserted when required for action. If safety-match composition is used there is less danger. If a quantity

of grenades are accidentally exploded the results will be serious, and one will find it safer at a considerable distance. Never hold on to a grenade or tell a funny story after it is alight—you may never reach the point.

All grenades should be treated with care, they are all dangerous, particularly those of the enemy, who sometimes throws unlighted grenades in the hope that we may do the lighting of the instantaneous fuse which he has innocently inserted for our destruction. The time of the fuses used in all grenades should be standardized, and this is being done, but one has no guarantee that those of enemy origin are similarly timed. Some types of grenades rely on the effect of explosion only, but it is better to increase the radius of action by means of missiles contained in, or resulting from, the disruption of the grenade itself. The brush-back or cricket-bat variety is really not a grenade at all, but is simply an improvised means of placing a high-explosive charge on the earthworks of the enemy because other means are impossible without undue exposure and consequent loss of life. Grenades proper are thrown by hand, and are sometimes classed according to weight, but this is unsatisfactory, as the weights vary considerably. Light grenades, about 1 lb. or a little over, can be thrown about 50 yards, whilst heavy grenades, 2 lbs. upwards, may be thrown not over 30 yards; these figures will depend on the design of the grenade and other circumstances.

"The effective area of a light grenade is mainly local, about 6 yards in diameter, but, when possible, it should not be thrown less than 20 yards in the open, as stones, &c., thrown up by the explosion, would be dangerous to the thrower.

"The danger area of the heavy grenade is about 30 yards in diameter, and, therefore, it should not be thrown less than 25 yards in the open. With all grenades the thrower should cover the eyes at the moment of explosion and protect himself, as small fragments of metal may carry further than the distances mentioned."

Time fuses for all grenades are standardized to five seconds, so that one and a half to two seconds should be used in the throwing. If thrown hastily, it may arrive at the enemy's trench too early, and give him sufficient time to return it against you.

There are many different types of grenades, but each has its own special advantages and uses, depending on the nature and time of attack. Expert grenadiers should have a good knowledge of each variety, and be able to tell the special qualities of each, but, more important still, should be able to impart the information to suit the men being instructed, remembering that it is easier to teach here and now, than in some distant land in face of the enemy. The instructor loses nothing by imparting all he knows and patiently answering the questions, however trivial, made by those anxious to learn.

INSTRUCTIONS FOR THE TRAINING AND EMPLOYMENT OF GRENADIERS.

Practical Training of Grenadiers.

Training will be conducted as laid down in the Memorandum for Training and Employment of Grenadiers, issued by the General Staff, General Head-quarters, which forms the first section in this pamphlet. Local instructions issued by the Director of Military Training, dated Melbourne, 17th January, 1916, is reproduced for information, also extracts from Orders, A.I.F., dated 8th June, 1915.

The following instructions are issued for the training of grenadiers:—

1. (i) (*a*) One officer, two sergeants, and 56 other ranks are to be trained in each battalion.

(*b*) One officer, two sergeants, and 28 other ranks are to be trained in each Light Horse regiment.

(*c*) Five per cent. of each Light Horse and Infantry reinforcements are to be trained similarly.

(ii) Theoretical instruction, based on the construction, appearance, properties, care, and maintenance of fuses (safety and instantaneous), detonators (service and commercial), and explosives (lyddite, dynamite, powder, and suitable commercial explosives) will be given by qualified officers. The following literature on the subject is suggested as likely to be of assistance in preparing lectures and dummy grenades:—

Appendix VII., Musketry Regulations, Part I. (Reprint, 1914).

"Professional Memoirs, Corps of Engineers, U.S. Army and Engineers' Department at Large."

"Notes from the Front," Part III., pp. 60-63.

"Trench Warfare"—*Royal Engineers' Journal*, 1909, p. 165.

"Treatise on Ammunition"—*Scientific American* of 8th May, 1915.

(iii) Practical instruction in making, storing, and handling improvised hand grenades from jam tins, &c.

(iv) Practical instruction in throwing dummy grenades.

(v) The organization of trench storming parties, including instruction in the preliminary arrangements, carrying, throwing grenades, and the further supply of grenades to the grenadiers. (See "Trench Warfare" and "Notes from the Front.")

2. *Personnel* selected for grenadiers will be trained soldiers who have completed their musketry course, and the object to be aimed at is to make a good soldier a good grenadier.

3. Until dummy grenades can be issued as an article of store, each party will improvise dummies of approximately 1 lb. weight from material available locally. Dummy stores, such as explosives, fuses, detonators, &c.,

can be made by any handy man from blocks of wood rope, and the brass shells of fired small arms ammunition.

FRANCIS HERITAGE, Lt.-Col.
For Chief of the General Staff.

Melbourne, 17th January, 1916.

EXTRACTS FROM ORDERS OF AUSTRALIAN IMPERIAL FORCE. DATED 8TH JUNE, 1915.

Bomb Throwing.

1. In every battalion and regiment of Light Horse ten men per company and squadron will be trained as bomb-throwers.

2. Courses for bomb-throwers will be organized regimentally forthwith.

The course will include:—

(i) Practice at throwing bombs over known distances into marked areas, which are to be rectangles of not more than 3 feet width, facing the thrower, and of any depth desired, to represent enemy trenches. Practice will be both from trenches and in the open.

(ii) Practice at lighting bombs, with the object of accustoming the thrower to the flash of the fuse and to the time taken to ignite and explode.

(iii) Practice in bomb-throwing drill. The training will be carried out under as practical and realistic conditions as possible.

3. Dummy bombs for practice will be drawn for the bomb party at the rate of six per battalion and regiment. They will not be used until the men are proficient in throwing stones of actual weight with the proper swing and necessary force.

Practice in Throwing.—This is the most important and difficult portion of the training, and every effort possible should be made to create interest in this part of the work.

It should be frequently impressed on all ranks that it is just as difficult to throw an expensive and intricate grenade as it is to throw one of the simpler and cheaper forms; also that the least complex are quite as deadly as the more intricate grenades, but that neither are of any use unless they reach the trench which forms the objective.

Short pithy lecturettes should be given on subjects such as the tactical uses of various types of grenades; Mechanical construction of individual grenades; Practical points with regard to their use; Care and maintenance of grenades; Sources of danger and how to avoid them; Storage, packing, and transport; Fuses (service and commercial); Construction, properties, and use of detonators; General properties of explosives, their practical use, and precautions to be observed; and Periscopes. These will create interest and lend variety to the practice. If the men are encouraged to make dummy jam-tin grenades, confidence will rapidly be created in their own powers.

Until other types of grenades are available, "Law-Adams" grenades may be used for practice. It is strongly urged that actual grenades be used, as men will put more energy—mental and physical—into the work if they know it is the real thing they are throwing, and not some inoffensive dummy, such as a ball or stone.

All concerned are hereby warned of the very great danger of using this or any other type of grenade with explosives of any kind until they are familiar with the construction and action of grenades, and have a sound theoretical and practical instruction with regard to fuses, explosives, &c. Live grenades are dangerous in the hands of the ignorant, but with careful instruction confidence will result, and with vigilant supervision especially in the initial stages,

the use of these for training need cause no anxiety if safety precautions be taken, The need for actual practical experience with live bombs has become apparent, and the more these are used the greater will be the efficiency of all concerned.

The following is suggested as a provisional course:—

1ST PRACTICE—*To insure Accuracy and Rapidity.*—Grenades will be thrown from a fixed position into a rectangle 3 feet x 3 feet at known and various distances, *e.g.*, 15, 20, 25, 30 yards.

2ND PRACTICE—*To accustom Personnel to Lighting a Fuse and Throwing immediately.*—It will be found that a certain nervous reaction at first seriously affects the accuracy of throwing, but after a little practice familiarity with the new conditions rapidly results in the practice becoming as good as it was originally.

NOTE.—It has been found that Chinese crackers inserted into the fuse plughole act admirably for carrying out this practice. These are cheap, and can be procured almost anywhere.

3RD PRACTICE—*To accustom Men to throw from Restricted Positions, as Trenches, &c.*—Trenches are now made narrow and deep, so conditions as nearly as possible approximating the present practice should be followed. Trenches 4 ft. 6 in. deep and 2 ft. 6 in. to 3 feet wide—from these, men would throw into another trench, say, 20 yards distant, variation in distance being introduced by directing men to throw diagonally to definite places or traverses.

4TH PRACTICE.—The same as in No. 3, but using safety fuse, 4 inches of which will burn approximately five seconds. There is no danger in this, and men soon become familiar with fuses and their peculiarities.

5TH PRACTICE.—*To accustom Grenadiers to throw Grenades with the least possible Exposure and to conceal their Position.*—Periscopes should be used in this practice. These can be effectively and cheaply made by the men themselves. Details of a simple and inexpensive periscope appear in Section 8 (page 38).

6TH PRACTICE.—In this practice bombing will take place along the trenches, and should be conducted by parties, detailed as laid down in paras. 5 and 6, Section 1, taking all precautions as if the trenches were occupied by an enemy. Bomb each section, throw over one or two traverses before advancing, and generally make the practice as realistic as possible.

7TH PRACTICE.—Live grenades to be used when the *personnel* are instructed as laid down by General Staff (para. 4, page 6).

SECTION 3.

PRIMITIVE FORMS OF IMPROVISED GRENADES.

"Brush-back" or "Cricket-bat" Types.

The simplest is one made by fixing a quantity of high explosive, fitted with time fuse and detonator, to a handle of wood. This, if it strikes a man, will probably blow him to pieces; if it just misses him, it will possibly severely injure him by concussion or shock; but the danger from flying splinters or missiles that will cause severe injury is reduced to a minimum. Grenades of this type have been in use, but are obviously very wasteful of explosive, dangerous alike to both friend and foe, and at the best are uneconomical. (*Vide* Plate I., fig. 2.)

The defects and limitations of such simple contrivances are so apparent that something more effective was soon forthcoming, and we find the advent of the now well-known "jam-tin" grenade. This is an improvement on the previous attempt, but it must not be overlooked that it is, after all, nothing more than something improvised from such articles as were available in the immediate vicinity, and a poor substitute for grenades as now supplied.

"Jam-tin" Grenade.

This, as its name signifies, is constructed from a jam tin, which forms the containing vessel. A hole is punched in the base or side of the tin to allow a fuse to project. If high explosives are used, the fuse must also be fitted with a detonator. Any high explosive which is procurable may be used with this form of grenade, but low explosives or propellants are useless without proper and effective tamping. The fuse, with detonator attached, is inserted into the high explosive and the explosive placed into the tin. Around the explosive is placed any material (that will withstand the shock of the explosion) to act as missiles. Pieces of iron, cartridge cases, nails, punchings, barbed wire, buttons, or any other pieces of irregular shaped metal would meet the requirement. When the grenade is exploded, such missiles will be driven with considerable force, and if the grenade misses the man, much damage is still possible, even at many yards distance. The effects of these grenades have been highly commented upon, and are regarded as most deadly, but they are not by any means as effective as it is possible for them to be manufactured with suitable appliances and conveniences. They are but an improvised type dictated by requirements and a limited quantity of material suitable for the construction of more effective designs. (*Vide* Plates II. and III.)

Jam tins are numerous, explosive plentiful, fuse and detonators can be obtained in the field, but when a supply of metal suitable for the filling is required, a difficulty arises immediately.

They are a bad shape for throwing, large internal pressures are an impossibility, they are but a poor substitute for the old grenade of cast iron used years ago, and are certainly not the type to make for use by our troops, if the greatest efficiency is aimed at, especially when every convenience is available for the production of grenades.

The construction of such jam-tin grenades is simple, and can be undertaken by any one with a full and comprehensive knowledge of the peculiarities and proper-

ties of fuses, explosives, and detonators which should be possessed by those intrusted with the making of these grenades.

There is little danger if the necessary precautions are observed, but it should be remembered that all bombs, grenades, and *explosives are dangerous and require care and knowledge in handling*, but the dangers diminish with increased knowledge and care in manipulation and avoidance of well-known sources of danger.

SECTION 4.

GRENADES.

Grenades may be grouped into three classes—

1. Those which require to be lighted by some external means of ignition.
2. Those which have some internal means of ignition and light automatically, or require some mechanical action to cause ignition.
3. Those which explode on impact or percussion.

Classes 1 and 2, of necessity, are provided with time fuses of various designs, which are usually timed for five seconds.

Apart from the improvised jam-tin and brush-back (also called cricket-bat at Gallipoli) types already described, the next representative of class 1 is the cricket-ball variety, which is the modern prototype of the original hand grenade, three of which are described below.

GRENADES.—CLASS 1—CRICKET-BALL TYPES.

(*a*) *Turkish, Gallipoli Grenade.*

This consists of a very rough cast-iron spherical ball of 3 inches in diameter, fitted with a hole for the introduction of the charge, tapped and screwed to receive a brass

fuse plug. The fuse plug has a hole in it through which the fuse is inserted, and is provided with a ring for carrying purposes. This grenade weighs 1 lb. 6 oz. unfilled, it can be thrown about 40 yards in the open. Reports from Gallipoli indicate that this is a very effective grenade. Any explosive may be used with it, but it is stated that its effects can be localised when smothered with a blanket or other material. (*Vide* Plate IV.)

(*b*) *The British Emergency Grenade.*

This is also of the cricket-ball type. It is made of iron, about the size of a cricket ball and beautifully finished in every way. It has a hole for a fuse plug and introduction of a charge. The fuse plug is made of iron, and screws into the hole, and fits flush with the exterior surface of the sphere, two tommy holes being provided to enable the plug to be screwed in. There is a small projection in the plug, with a hole in it, provided with about 6 inches of copper wire, which is used to hold the fuse, or Brock lighter, in position. The weight is approximately 1 lb. 7½ oz. unfilled. Any explosive could be used in this grenade. Bellite has been used as explosive. (*Vide* Plate V.)

(*c*) *Australian "Law-Adams" Grenade.*

This grenade is made of cast iron, is 2¾ inches in diameter, and weighs 1 lb. 4 oz. It is similar to the British Emergency and Turkish grenades, being provided with a hole into which is screwed a brass or gunmetal fuse plug, which carries the fuse. The hole also serves the purpose of inserting the charge. The fuse plug is fitted with a loop for convenience in carrying. The fuse recommended is the ordinary service slow fuse, which, when used with high explosives, must be fitted with a detonator. When available, "Brock" lighters should be used.

The specific improvement in this grenade consists of the *internal* segmentation, which on explosion causes the grenade to break up into well-defined segments of

a curved triangular shape, sharp pointed, and sharp edged. The bursting pressure of this grenade is exceedingly high, requiring internal pressures of from 20 to 37 tons to cause fracture. On account of the large size of the segments and the enormous velocity with which they are projected, it is doubtful if a blanket or similar substance could smother them, but this point has not yet been settled by actual experiments.

Any explosive may be used, either slow burning or high explosives.

The radius of action on explosion is not less than 40 yards. Individual segments have been found to penetrate 1 inch of pine.

Grenades of this type are now available for training purposes, but jam-tin and other varieties should be used, also, where possible, to accustom grenadiers to adapt themselves to local circumstances and supplies. (*Vide* Plate VI.)

There are many other examples of Class 1, but they are similar to those described, little variations are introduced for special purposes, as, for example, when it is desired to use a deliquescent explosive, or when it is found necessary to employ cast or wrought iron for fuse plugs instead of brass or gunmetal. These alterations need cause no confusion, a little consideration will show the object in view in each case.

SECTION 5.

Grenades.—Class 2.

Those which have some internal means of ignition and light automatically, or require some mechanical action to cause ignition.

In this class of grenade the ideal aimed at is to cause the grenade to light after it has been thrown. So many serious accidents have occurred owing to fuses being made of various time lengths that it seemed desirable, if possible, to make the grenade light automatically.

For tactical reasons also such an arrangement has been found exceedingly useful. The idea is good, but the practical methods of carrying it out make the grenade complex, and if absolute safety is desired the grenades require to be very carefully made, whilst the cost is enormously increased without any increased efficiency on explosion. One great general objection to this type is that the fuse burns for five seconds after it has been thrown, consequently it is difficult to control the bursting by one's own judgment, as can be done in the case of the simple fuse.

It is necessary to time the grenade before throwing, to compensate for distance, so that the grenade will explode when and where it is desired.

Some cricket-ball types are provided with a fuse plug and friction-lighting arrangement. The mere pulling of a wire ignites the fuse, which is timed for five seconds, as already indicated in other instances. It is usual with this particular type to wear a strap buckled round the wrist with cord attached. On the end of the cord is a swivel hook, which hooks on to the grenade friction-fuse rod. On throwing the grenade, the friction rod is jerked out, and the grenade automatically lights, at some distance from the thrower. (*Vide* Plate VII.)

The strap and cord remain with the thrower, and are ready for further use. In some cases, the cord is attached to the finger, but the principle is the same. This type is extensively used by the French on the Western Front. (*Vide* "Notes from the Front," Part III., pp. 62-63.)

The Pitcher Grenade.

This is another example of Class 2. (*Vide* Plate VIII.)

The pitcher grenade consists of a cylindrical cast-iron case 4 inches long and 2 inches external diameter, segmented outside and closed at the bottom. In shape it is like a Brasso or Brilliantshine tin, only made of cast iron. Into this case is placed a metal cylinder

containing the explosive charge (4 oz. of ammonal, time fuse, and detonator). The top is provided with a brass cap, which is fitted with a bridge piece for attaching a piece of tape to. The cap is secured to the tin by a bayonet joint, and the tape is packed inside the grenade; on removing the cap a piece of tape will be found to be attached to the fuse tube. On pulling this tape the grenade will light. The tube for the fuse has a gutter on one side of it, into which the tape, 6 inches long, is packed, and on the upper end of the tube match-head composition is placed, and so arranged that the tape rubs over this, and, by friction, ignites the time fuse. Time of fuse, five seconds. Any high explosive may be used—bellite, lyddite, &c.

In this case there is a mechanical lighting arrangement as described, but the grenade may be held and thrown when one's judgment dictates. This is not an ideal shape for throwing, and, although probably effective from an explosive point of view, it does not appear to be as good as other types which already exist, and is fairly expensive. On explosion, the cast-iron case breaks up into pieces, which act as missiles and cause damage (quite apart from the shock of detonation) for some considerable distance. There are two sizes of this grenade—heavy and light.

The "Mills" Hand Grenade.

The next example of Class 2 is the "Mills" hand grenade, known in the Service as Grenade Hand No. 5, Mark I. (*Vide* Fig. IX.)

This grenade consists of a cast-iron externally segmented shell, roughly egg shaped. It is provided with a mechanical striking arrangement contained in the body of the grenade. The striker is operated by a spiral spring, which is normally in compression, being kept so by an external lever, which lies flush with the outside. A safety-pin keeps this lever in position. If this safety-pin be removed, the spiral spring displaces the lever,

and the striking mechanism ignites the time fuse by means of a percussion cap.

If the grenade is held in the hand, however, so that the lever is covered by the hand, the safety-pin may be removed—the hand holding the lever in position—but immediately it is thrown the spring overcomes the effect of the lever, and the lever is disengaged, and the grenade ignites.

This striking mechanism is very neat and effective, and for certain tactical requirements makes a most useful addition to the grenades in use.

The igniting device is contained in an aluminium case in which two parallel holes are bored. The larger hole contains the striking pin while the separate component comprising percussion cap, fuse, and detonator, are made " U " shape and lead into the smaller hole. A reference to the sketch will show the method of arrangement. Access to these holes is gained by removing the aluminium plug at the base of the grenade. On the side of the grenade is a screwed plug-hole for the insertion of the explosive T.N.T. (tri-nitrotoluene) or other high explosive. This grenade is, without exception, one of the most carefully designed in use. It is very expensive, very reliable, and safe. It is open to the objection that no provision is made to vary the fuse length, so that the grenade may be timed according to the distance thrown. If the lever is removed in the hand and the difficulty got over by this means, many of the advantages of the intricate and expensive automatic lighting mechanism disappear. There are other examples of Class 3 which have internal or external mechanism to cause ignition, some with springs to do the work, others which require the grenade to be struck on a hard substance, but the ideas are the same, viz., to ignite a time fuse contained inside of the grenade itself. To compensate for distance, it is necessary to vary the height at which the grenade is thrown. One man can carry 25 of these grenades in a box, sand-bag, or basket. These grenades are being extensively used on the French front at present; they weigh 1 lb. 4 oz.

[Extract from "*Information to Guide Instruction in the use of Rifle and Hand Grenades.*"]

Hand Grenades Nos. 6 and 7, Mark I.

Description.

The grenades consist of tin vessels filled with high explosive, and are packed 40 in each packing case, with four haversacks. The heavy grenade, weight about 1 lb. 13 oz., contains an outer layer of scrap iron. The igniter socket is closed by a wooden plug for transit, and covered by a papier-maché cap.

The light grenade is entirely filled with explosive; weight, slightly over 1 lb. (*Vide* Plates X. and XI.)

The igniters and detonators, packed ten in a tin and 40 in each packing case, consist of a friction igniter, a length of safety fuse, and a service detonator. The friction igniter consists of the holder, to which is fixed a flange with two notches and two springs. It also has two horns, which form a grip for turning the igniter into the locked position. The friction bar is fixed to a button, through which the firing loop passes. The haversack is intended to be carried similarly to the ordinary service haversack, but the sling is shorter, to cause the grenades to rest above the hip, and, as far as possible, clear of other equipment. The loose strings should be tied round the waist to prevent the pockets sagging and the grenades knocking against one another.

Preparation of Grenade.

Remove papier-mâché cap and the wooden plug from the igniter socket. Tear the strip from the tin box containing the ten igniters, insert an igniter in the socket, so that the notches in the flange pass over the brass studs on the grenade. Turn the igniter in either direction until it is locked by the springs on the flange and one of the studs, which is then held between the two springs. If it is required to remove an igniter, one of the springs must be kept pressed down while the igniter is turned till the spring is clear of the stud. Replace the papier-mâché cap and place the grenade in a pocket of the haversack with the cap uppermost.

Firing the Grenade.

Remove the papier-mâché cap; hold the grenade in the right (or throwing) hand, so that the igniter is towards the wrist, the forefinger over the bottom of the grenade; pass the forefinger of the other hand through the firing loop, and, when ready to throw, pull with a sharp jerk. If a couple of steps are then taken and the grenade bowled or thrown, it should explode soon after reaching the mark.

"Welsh Berry" Hand Grenade.

This grenade is of the jam-tin variety, but the lighting device brings it under Class 2. It consists of a tin 2½ inches deep by 2 inches in diameter, with a lid made out of pressed tin plate. A tin tube, 1 inch in diameter, is fitted in the centre of the tin. Between this tin tube and the outer case, missiles consisting of dumps or irregular pieces of iron, are inserted, the whole being kept in position by a covering of resinous material. The inner tube is lined with cardboard, and is intended for the explosive. In this connexion it is important to note the cardboard lining; many explosives deteriorate, or may form dangerous compounds, when in contact with metal.

The lid acts as a cover and support for two tubes made of iron with very large flanges. These give the lid more rigidity, and add strength to the cover. The upper tube carries a detonator cap and anvil, and a hole is provided in this tube, and also the lower one, through which the time fuse passes.

The grenade is ignited by giving the percussion cap a sharp blow on some hard substance. The percussion cap is protected by a cover made of tin, which renders the grenade safe in transit. The detonator and explosive are not inserted until the grenade is required for use.

A reference to the diagram will make the construction of this grenade clear. (Plate XII.)

On the outer case, the instructions given are as follow:—

"Welsh Berry" Hand Grenades with Pellets.

Instructions.

1. Keep the safety clip, which protects the percussion cap, on the fuse plug until you are ready to throw the grenade.
2. To fire, hold the grenade in the throwing hand. Give the percussion cap a sharp blow against a hard surface, and throw at once. The grenade will explode between four and a half and five seconds after the percussion cap is struck. As a large number of these grenades has already been ordered, and will probably be used by Australian troops at the front, special attention should be given to the construction and method of use of this grenade.

Cricket-ball Type.

A similar lighting arrangement to that just described above has been provided for a cast-iron cricket-ball type of grenade. The use of such will be precisely similar to the "Welsh Berry" hand grenade, the advantage being in this case, however, that the shell will break into irregular fragments, and altogether forms a more useful and better-designed grenade, easier to throw and more liable to reach its mark on account of its shape.

SECTION 6.

GRENADES—CLASS 3.

In this class are placed all grenades which explode on impact or concussion; they are, in some ways, the most dangerous type, because once the safety-pin has been removed it only requires a blow to cause detonation. Those with the long handle and streamers appear to be particularly open to objection in restricted positions, such as trenches, and, although the shape and design may allow of greater range and certainty of explosion on reaching the enemy trench, still it is procured at greater danger to ourselves, and is therefore a doubtful advantage.

Grenade, Hand, No. 1, Mark II.

Grenade, Mark I, is described in Musketry Regulations, pp. 200-203.

The Grenade, Mark II., consists of a brass cylinder encircled by a narrow cast-iron ring serrated to break up into sixteen fragments. The cylinder is mounted on a wood block, to which a cane handle, with streamers, is attached. The brass cylinder or body of the grenade is filled with explosive, and has its upper end closed by the detonator holder, fixed by three screws. This holder carries two pins for securing the detonator. The body has fitted above the serrated ring two indicating stops, painted red. The firing needle is carried in the removable cap, which has two grooves formed on it, in which slide the knobs on the body. The cap is centrally pierced for the safety-pin.

On the outer surface of the cap are stamped the words "remove," "travel," and "fire." When the knobs are in the groove "remove," as indicated by the stops, the cap can be removed and replaced; the central position, marked "travel," is to be adhered to normally; while in the position "fire," the cap, after removal of the safety-pin, is held in position by friction only, and can be pressed inwards to fire the grenade.

The action of the grenade is simply that the cap is forced in on impact, carrying the needle on to the detonator, the cap having been turned into the position "fire," and the safety-pin having been removed before throwing.

Packing.—The grenades are packed six in a wooden box. Cylinders—containing ten detonators, No. 1 hand grenade, Mark I. or II.—are issued separately.

Preparation.—The cap is removed, a detonator inserted in the recess, the grooves in the detonator being placed opposite the pins on the body, and the detonator is then pressed home and turned to the left (its flange being under the heads of the two pins) until the spring on the detonator flange is released, thus locking it in position. The cap is then replaced and turned into the position "travel." The safety pin must on no account be withdrawn during these operations.

The cap from one grenade will not invariably fit another grenade well, and steps should be taken to prevent caps and grenades being interchanged.

Throwing the Grenade.

When it is required to use the grenades, all on the belt should be turned to "fire," and the whipcord beckets and leather strips should be removed from the safety pins.

When a grenade is taken from the belt, the streamer is unwound and allowed to hang free, and the safety pin is withdrawn immediately before throwing.

The grenade is grasped by the end of the handle and thrown in the required direction, care being taken that the streamer does not get entangled with the thrower.

To insure the grenade firing on impact, it should be thrown well upwards, at an angle of not less than 35 degrees.

Should the grenade not be used, the cap should be turned back to "travel," and the safety pin replaced and secured by passing the whipcord becket over the cap and threading the leather strip through the slot in the end of the safety pin. (*Vide* diagram No. XIII.)

THE MEXICAN GRENADE—GRENADE, HAND—HALES' PATENT.

This is another example of Class 3, and is similar to the one already described, but it will be observed on reference to Plates XIV. and XV. that the means of ignition is designed differently. The grenade has a brass body with an internal tube, in which is placed the detonator holder and cap, also the needle pellet. This pellet is securely held in position by the safety pin, which, when removed, allows the pellet carrying the striking steel needle to fall forward on to the detonating cap, but it is prevented from doing so by a small brass spiral spring, called a creep spring. When the grenade strikes an object, or is suddenly arrested in its flight, the inertia of the spring is overcome, and the needle strikes the

percussion cap, which in turn explodes the detonator. On the upper end of the internal tube is screwed a detonator holder, into which the detonator and cap is placed. The grenade is provided with a segmented cast-iron ring, and is charged with high explosive, as in other cases. A reference to the diagram will make the action of this grenade clear. It is advisable to fully understand the action of this grenade, as the action of the rifle grenade, to be described later, is similar, only with a more complex arrangement of release.

Other types of this class of grenade exist, *i.e.*, with handle and streamers, but there are also some of the cricket-ball style, that explode on impact and come under this class. As is usual in the preliminary stages of invention, classes and types multiply, but eventually a definite standard of each type will become recognised and adopted for further use, just as one type of rifle is common throughout the service of a nation, but until that stage is reached it is necessary to ascertain the most suitable type for general requirements.

Hand Grenade.

This is another example of Class 3 of Australian origin, which embodies the "Welsh Berry" lighting device. This grenade is of the British No. 1 Mark I. and Mexican types. The grenade is made of tinned sheet iron, the body being a conical vessel containing small pellets of iron, and forming the head or striking end of the grenade. A tin tube containing the explosive, detonator, and cap forms the handle, and passes through the conical top, and on which the body slides, when sufficient pressure is applied to overcome the resistance of an internal spiral spring placed in the head of the grenade. (*Vide* Plate XVI.)

On pressing the top of the grenade vigorously, or by giving it a blow or knock, the body of the grenade is pressed backwards and detonates the percussion cap, which explodes the grenade. Explosives may be inserted at the last moment by removing the small wooden handle at the foot.

A cardboard tube fits into the tin tube, and is closed by means of a cork. On removing the cork (a piece of tape is provided for such purpose) the explosive may be inserted. The grenade is fitted with a safety device consisting of a bent piece of tin held in position by means of paper and tape. Until this is removed the grenade is perfectly safe.

To use the grenade, undo the tape attached to safety device, pull sharply, when the safety clip will be removed. The grenade is then ready for action, and will explode immediately on percussion. The grenade is simple and effective, but cheap and elementary in design compared with others previously described. It will be noted there is no segmented ring on this grenade, the missiles being provided by the dumps contained in the conical body referred to. Half-a-dozen streamers are attached to the end of the grenade to insure that the grenade will fall on its head.

SECTION 7.

The Rifle Grenade.

Grenade, .303 *Short Rifle, No.* 3, *Mark I.* (*J. Pattern*).

This is one of the finest examples of Class 3, and is without exception one of the best-designed in use. It is finely finished, and this is necessary in order to get accurate flight, which would be impossible if it were not well balanced. It consists of a mild-steel cylinder accurately turned both outside and inside. The outside is deeply grooved or serrated, like a motor-cycle cylinder, and in addition, it is grooved or serrated vertically, so that on explosion it flies into numerous fragments of a pre-determined size. The inside is quite smooth. (*Vide* Plate XVII.) The length of the cylinder or body is 3½ inches, while the external diameter is 1½ inches and the internal diameter 1 3-16 inches. The top and bottom are closed by means of brass plugs. The top end is fitted with a screw for the insertion of the detonator. Down the centre is a brass tube 7-16 inch in diameter, and between this tube and the iron cylinder

the explosive is placed. The central brass tube carries the detonator and striker. The striker is a rod of brass 2⅜ inches long and ⅜ inch in diameter. It is fitted with a needle point around which is a light, brass, spiral spring (creep spring), which prevents the needle touching the percussion cap until the grenade is suddenly stopped by some obstruction. A brass socket screws into the lower end of the iron cylinder; this is bored out, and forms practically a tube into which the end of the striker fits loosely. Two holes are bored and recessed to receive two retaining pins, which, in turn, fit into a recess in the striking pin and hold it in position till free to fall out. These retaining pins would fall out unless covered in some way, so a screwed collar carrying a neat little windmill or vane is screwed to and covers them, and holds them in position. Below this wind-vane is a loose brass collar, which would fall down the socket but is prevented from doing so by a safety pin, which keeps it in position and hard up against the bottom of the screwed wind-vane. Into the bottom of the brass socket is screwed a steel rod 10 inches long, which fits into the rifle barrel, and which is securely, but lightly, held in position by a steel spring clip.

Action of the Grenade when Fired.

The grenade rod is placed into the barrel of the rifle; the safety pin is removed after a blank charge has been inserted into the chamber. On firing, the shock causes the collar under the wind-vane to slip downwards, this frees the wind-vane and the force of the air causes it to rotate. It has been found necessary to pull the collar down and give the wind-vane about one turn, instead of trusting to the shock of explosion to cause the initial movement. The wind-vane, being screwed, unwinds itself and frees the two retaining bolts, which holds the striker in position, the striker falls forward and balances on the small spiral creep-spring already alluded to. The grenade is now very sensitive, and will readily explode on the slightest impact or concussion. A reference to the diagram will make the action clear. The weight of this grenade is aproximately 1 lb. 2 oz.

The range is 200 yards. There are a number of precautions which must be observed in using this grenade. Old rifles—short .303—should be used; the action of this grenade is not conducive to improving the shooting qualities of the rifle. Old rifles, at the rate of two per platoon, are issued for this purpose. There is no gyroscopic motion with this grenade. Ball cartridge *must not be used,* as this will burst the rifle. Blank cartridge is not suitable, but a ball cartridge from which the bullet has been removed is suitable. Special cartridges are supplied. Don't try and fire the rifle with grenade from the shoulder, the recoil will impress the importance of this advice. The rifle should be rigged up with a special stand and suitable sights, for in this case one is really using high-angle fire, for which the ordinary sights are useless.

The safety pin should be in position until about to fire, the detonator is also inserted when the grenade is about to be used. The explosive used is bellite, T.N.T., or other high explosive. The grenade explodes on impact, and is suitable when the trenches are some distance apart, too far for the ordinary hand grenade. At first, the spring on striker was made too strong, and many failed to explode when striking the wire netting which the Germans used to protect their trenches from grenades, &c., but this defect has been remedied—the spring is made more sensitive.

Package of Grenades.—The wooden box provided carries twenty grenades in protecting tins with screw-off lids, twenty detonators, rifle grenades in four tin boxes with lever lids, and 22 special blank cartridges in a tin box.

Preparation for Firing.—The grenade is removed from its tin, and the ebonite plug in its head is unscrewed by hand. The grenade is held nose down to make sure that the needle pellet is held by the retaining bolts.

If correct, the detonator is inserted and screwed home.

The rod is then gently lowered into the rifle, the clips sprung on to the muzzle, and a blank cartridge inserted in the chamber.

The safety pin is withdrawn just before firing.

If, after the safety pin has been removed, the grenade is not used, the safety pin may be replaced if the screwed ring has not unscrewed and uncovered the two retaining bolts, but if these are uncovered the grenade is in a dangerously sensitive condition, and if so found it should be destroyed. Only the special detonators and cartridges provided should be used. If by accident a grenade were fired with a bulleted round, the rifle would probably burst and injure the firer.

This grenade is very safe to handle, as it cannot be fired by knocking or dropping on the ground; it must travel through the air some distance before the retaining bolts fall out.

[Extract from "*Notes from the Front, Part IV.*"]

NOTES BY AN OFFICER EMPLOYED IN CHARGE OF THE GRENADIERS OF A DIVISION.

(i) *Rifle Grenades.*—The rod is officially rust proof, but it rusts in the trenches, and should be kept oiled.

(ii) In carrying the grenade, the head of the grenade should be held and not the rod. The weight of the grenade is apt to bend the rod, which will then not fit into the barrel.

(iii) The box sight is too clumsy, and depends too much on the ground being level. In practice, men can learn to judge the elevation by observing the trajectory of the grenade in flight.

(iv) The firer should stand well back from the parapet, as the grenade, if shown over the parapet, draws fire.

(v) The detonators are packed in cotton wool, which absorbs a great deal of wet when a tin is once opened. This may cause the detonators left in the tin to become defective.

(vi) An enemy machine-gun interfering with a working party at night was silenced by rifle grenades.

(vii) An experiment was tried by shooting rifle grenades point-blank at the loopholes and parapets of the trenches where snipers were active. This was done with great effect, and all sniping ceased in a very short time. This method was found to be a much more accurate way of firing the rifle grenades.

(viii) *Hand Grenades.*—The trench for instruction should have a parapet front and rear, as one of the difficulties is to avoid striking the grenade against the rear parapet.

Pendulum Dial Sight.

A pendulum dial sight, graduated in yards, for direct aim or high elevation, is issued for use with rifle grenades, and can be easily affixed to the leaf of the backsight. Should the sight not fit tightly on the leaf, the spring sides should be slightly pinched in.

MISCELLANEOUS.

Under this heading is included a number of grenades which are ingenious in some respects but possessing no advantages over those already in use. In some cases the primary use of a grenade is lost sight of amidst a complication of spring levers, triggers, and fuses of fearful and wonderful designs. There is one the shape of a boomerang, containing the explosive charge at the bend or angle of the boomerang, invented by Russel-Sutton, which has peculiarities and is worthy of mention, being unique in design, and if the areo-dynamics were not so complex might have its uses under certain circumstances, but, unfortunately, these circumstances can be better coped with by other engines of destruction. Much training is necessary to use this type, and it suffers from the lack of uniformity in balance and flight. (*Vide* Plate XIX, 2.)

There is one also of the jumping-jack species, which is reputed to be capable of complex movement and very deadly in its action; it may do all that is claimed of it, but one has not heard of its practical application.

After a careful study of the meagre facts and examination of several types, one is lead to regard the old original spherical ball as the most useful and simple form of hand grenade. There being no gyroscopic action possible with a hand grenade, it is the most suitable and scientific shape. It is very cheap, and its powers on explosion are fully equal to the more complex shapes. It may be of Class I., and is then simplicity itself. If Class II. type is desired, this is easily obtained by making the fuse plug with a friction lighter; if Class III. is required, then it is only necessary to insert a handle in the fuse plug and concussion detonator in the handle. The ball gives the least air resistance and uniform pressures, while it allows the centre of gravity to be well forward, so that there will then be no question of the grenade falling head downward, and streamers can be abolished.

SECTION 8.

TRENCH PERISCOPES.

The dangers of exposure are so obvious in trench warfare that if one can see without being seen much valuable life will be saved, and more accurate information obtained when the observer knows he is quite safe while observing. The use of the periscope permits safe observation, and such instruments should be used wherever possible, and supplied in sufficient numbers to all troops engaged in this phase of warfare. They can be easily improvised for the use of grenadiers, the following information will enable any grenadier to make a periscope for himself.

Simple Improvised Periscope for Use of Grenadiers.

A periscope is an optical instrument used for observation over or round cover without exposing the person using it. There are many varieties and designs, but the

essential requirements are two plain mirrors fixed in the same vertical plane and set at a distance from but parallel to each other at an angle of 45 degrees with the vertical. These mirrors may be held by light skeleton metalwork, in which case they may be made very light and portable, but are usually expensive. On the other hand, they may be arranged in box form, when they are more efficient optically, stronger, and less liable to damage, but obviously are not so portable. All that is necessary is a wooden box 16 x 5 x 4, with an opening 3½ x 3½ in the side marked "A" (*vide* Plate XVIII.), and another similar opening on the side marked "B." Two mirrors—"M"—each 4 inches x 4 inches, are set at an angle of 45 degrees with the vertical. The rays of light from the object to be viewed strike the upper mirror and are reflected at 90 degrees down to the lower mirror, and are then again reflected at an angle of 90 degrees. The inside of the box should be blackened, for example, with aniline black. It should be noted that this instrument can be used with field glasses, and, except for a slight loss of light due to reflections and minor imperfections of the mirror, distant objects can be viewed with perfect clearness, safety, and absolute concealment. Using a kerosene case, a few nails, and two pieces of mirror 4 x 4, the cost of which will be 6d., it will be seen that an efficient periscope, as suggested, can be made by any handy grenadier. It is strongly urged that grenadiers make such periscopes for practice purposes when throwing grenades. (*Vide* "Instructions for Training," page 18.)

The length in sketch—16 inches—is a matter of no importance, they may equally well be made 2 or 3 feet. The size of the mirrors can be varied, if desired; there is little use increasing the vertical depth of the mirrors unless one is looking for air-craft, but the horizontal length may be increased with advantage, especially if one desires to use field glasses, the 3½ inches being rather restricted opening. Periscopes are a very old invention, but are specially suitable for the present style of warfare. The periscopes used for submarine work

are similar in principle, only more perfect optical arrangements are used—the mirrors are replaced by reflecting prisms, and also magnifying systems are introduced, and means adopted to increase the horizontal angle of view.

From the principles above-mentioned the use of the periscope to a rifle will readily be understood, but the last word has not been said in this direction, at present it is only an improvised arrangement in the best of them, and until first principles are adhered to and conventionalities are discarded, a neat and serviceable weapon will not be forthcoming.

SECTION 9.

FUSES.

There are two types of fuse used in the Service, known as "Fuse Safety, No. 9," or more generally as "Bickford's," and the "Fuse Instantaneous," Mark III.

They are readily distinguished from one another—first, by the colour, the safety fuse being *black*, and the instantaneous *orange*. They can also be distinguished in the dark, as the instantaneous fuse has a snaking of thread on the outside, so that it is rough to the feel.

The safety fuse burns at the rate of, approximately, 4 feet per minute, and the instantaneous at the rate of 30 yards per second. (See Plate XIX., v, vi.)

Caution.

The instantaneous fuse is quite useless for grenades.

Construction.

The safety fuse consists of "flax spun and twisted in the same manner as in twine-twisting or cord-making, with a core of fine gunpowder in the centre.

The flax is covered with guttapercha, and has an exterior coating of tape and varnish, which delays the oxidation of the guttapercha. It is supplied in hermetically sealed tins containing 8, 24, or 50 fathoms. This fuse is coloured black, and will burn under water at a depth of 90 feet after 24 hours' immersion." (M.E., Part 4, page 35.)

The rate of burning of all fuses is liable to alteration due to various causes—climatic, chemical, and mechanical. It is therefore always advisable to test the rate of burning by an actual trial. To do this, cut off accurately a known length, say, 1 or 2 feet, light it, and measure the time of burning. If it should become necessary to use commercial fuse, the above precaution is most necessary, as the rates of burning are different from the Service fuse. It is very dangerous to have fuses of different rates of burning; the Service fuse, therefore, should be used when possible. Always use good fuse, because unreliable fuse is very dangerous in many ways.

Fuses are now tested by X-rays, which show up any defects in the internal powder column, and a defective fuse is rejected.

Lighting a Fuse.

Cut at an angle, so as to expose the powder column as much as possible. A matchhead or flake of guncotton placed in or on the end materially assists ignition. The difficulties in igniting fuse are due to the melting of the guttapercha, which thus exudes and covers up the powder column, rendering ignition difficult.

A port fire, slow match, cigarette, and fusee are suitable means to ignite fuse.

The usual length of fuse used is timed for five seconds; 4 inches, therefore, of Service fuse should burn approximately five seconds.

Improvements for Lighting.

On account of the difficulties of readily igniting a fuse (a matter of vital importance to grenadiers), fuses are sometimes coated with matchhead composition,

which is suitably protected from the weather, &c., by metal cap or tube. There are two kinds of matchhead —those which contain phosphorus and those which do not. The former ignite by simple friction, the same as a wax match; the latter require to be rubbed on a prepared surface containing red phosphorus, in exactly the same way as one strikes a safety match on the prepared surface of the box. With the latter type a brassard (worn on the left arm) is used to light the fuse by friction on its prepared surface.

BRASSARD.

A brassard is an article used by grenadiers to ignite grenades. It is worn on the left forearm, being secured by a strap or tied on by tapes. The size is quite immaterial. They may be made of wood, stiff canvas, linoleum, &c., and are coated with red phosphorus compound, the same as that used on the striking surface of a safety matchbox. The fuse for use with brassards is coated with a substance of the same composition as that used on the head of a safety match. The diagram shows a simple, but effective, brassard, dimensions 3¼ inches x 2¼ inches, made of wood slightly curved (*vide* sketch), tapes, khaki, each 2 feet long and ¾ inch wide, are tacked on to the wood, care being taken that the tacks do not protrude through the striking surface.

If one runs short of brassards, the striking surface of a safety matchbox held in a small tin clip, with tape attached, could be used.

SLOW MATCH.

Slow match can be made by steeping rope in a solution of saltpetre (potassium nitrate) and limewater and allowing the rope to dry, when it will burn at the rate of, approximately, 1 foot per hour.

QUICK MATCH.

This is made by boiling three strands of cotton wick in a liquid containing mealed powder and gum, then dusting the cotton with mealed powder before it becomes dry. It is then enclosed with flax so as to carry the flame along rapidly.

PORTFIRES.

Portfire, common, consists of a cylinder about 16 inches long and rather more than ½-in. diameter. It is made of stout brown paper, pasted, rolled, and, when dry, turned in at one end to form a bottom. The case or cylinder is driven with portfire composition.

The top has a small hole bored in the composition, and is primed with mealed powder to make it light easily. They burn from twelve to fifteen minutes, and are generally lighted by a slow match. They may be lit also by any means handy, as a vesuvian, a burning stick, &c.

Painted flesh colour.

SECTION 10.

DETONATORS FOR USE IN HAND GRENADES.

Detonators are small metal tubes containing fulminate of mercury, which is an exceedingly violent and dangerous explosive, exploding on slight friction or percussion, or when heated to 360 degrees Fahr.

Detonators are used to explode or detonate less explosive substances, which substance, in turn, may be used to explode or detonate still less explosive compounds. For example, wet guncotton is very difficult to detonate, dry guncotton is easy to detonate, and fulminate of mercury very easily detonated. To ignite a charge of 15 oz. of wet guncotton it is necessary to detonate it with dry guncotton—1 oz. dry primer being

used to detonate it—the dry guncotton being detonated with a detonator containing 35 grains of fulminate of mercury. A detonator alone is sufficient for explosion of the usual commercial explosives.

There is a vast difference between ignition and detonation, but the subject is too complex to explain here. Text-books for explosives should be referred to for further information on this subject.

Gunpowder in a grenade can be exploded by simply using a fuse, but to properly explode dynamite, guncotton, gelignite, tri-nitro-toluene, lyddite, &c., a detonator must be used if the full value of those so-called high explosives is to be attained.

Service Detonator.

The detonator used in the Service is designated No. 8, Mark IV., and contains 35 grains of fulminate of mercury placed in a tapered metal tube 2½ inches long and nearly as large in diameter as an ordinary lead pencil. The end containing the fulminate is closed, the other end is left open, so as to receive the fuse. Over the fulminate is placed a plug of wood with a hole in it, through which passes a small piece of quick-match. The detonator is held on to the fuse by simply pinching the tube. There are special pincers used for this purpose. This operation is necessary, otherwise the fuse is liable to be blown out, and may prevent ignition.

Those detonators are painted red, and require the greatest possible care in handling, there being sufficient explosive in the detonators themselves to cause serious bodily injury. (*Vide* Plate XIX., iii., iv.)

Commercial Detonators.

Commercial detonators are made of solid-drawn copper tubes closed at one end and partially filled with an explosive compound, viz., fulminate mercury and chlorate of potash.

They are made in various sizes, and numbered 1 to 8.

No. 3 is 26 millimeters in length and 5.5 millimeters in diameter, and contains 8.3 grains of fulminate.

No. 6 is 35 millimeters in length and 6 millimeters in diameter, and contains 15.4 grains of fulminate.

No. 8 is 55 millimeters in length and 6 millimeters in diameter, and contains 30.9 grains of fulminate.

No. 6 is suitable for most commercial explosives, but the No. 8 detonator is required for exploding some of the less sensitive explosives, such as the nitrate of ammonium compounds.

Commercial detonators are packed in boxes of 100, and require to be handled with the same care as the Service detonator. In some ways the Commercial detonators (especially on account of their short length) are more suitable for grenades than the Service detonator. They are very much cheaper, and quite reliable. They are fixed on to the fuse by means of a special pair of nippers, but miners, who are constantly handling them, nearly always do the compressing with their teeth. This is all right if one bites the right end, but it is a dangerous practice, and should never be allowed.

Detonators should at all times, unless when actually being used for detonating purposes, be kept separate and apart from explosives of all kinds. The safest way to keep them is to bury the box containing them, and under no circumstances should they be stored with other explosives.

SECTION 11.

EXPLOSIVES.

Officers and expert grenadiers should have some elementary technical knowledge of explosives they are likely to handle when dealing with grenades. The following notes on explosives may be found useful for instructional purposes:—

Many substances explode under certain conditions. By that it is meant that there is a sudden disruption

of matter, and usually there is an enormous increase in volume. Certain substances, however, explode witho any increase in volume due to internal strain or stress, &c. From time to time one hears of explosions of coal dust, flour, and other solids, in which case it is really a very rapid combustion due to the substances being intimately mixed with air. The heat generated and the by-products of combustion occupying a very much greater volume than before cause the effect of explosion.

An explosive, as generally understood, is a substance composed of combustible matter and containing its own supporter of combustion. This may be oxygen derived from certain salts, but it need not necessarily be so. It may be expected that there is always a change of initial volume on explosion, though that volume may ultimately resort to normal. Such changes do not take place instantaneously, but require a certain duration of time for the actions to complete themselves, but the time necessary for complete explosion to take place is varied in different explosives. Those which take comparatively long time are called low explosives, and are usually employed as propellants, for example, gunpowder and cordite. It should be noted that these substances do not burn or explode at a given definite rate, but even with them the time varies, according to the size of the grain in the case of gunpowder, or on the dimension of the cord's thickness in the case of cordite. If a large gun using gunpowder were charged with fine grain, such as is used in a Martini-Henry cartridge, it would probably burst, but if charged with prism powder the propellant effect would be attained without undue pressures. Likewise with cordite, if the fine cords used in a .303 cartridge were employed in charging a 16-in. gun, disastrous results would ensue, yet the same weight of cordite, if made in large dimensions, is used without trouble, because the larger pieces require a longer time to burn, and the time of explosion is therefore prolonged. Other explosives are very rapid in action, so rapid that they cannot be used as propellants (except when suitably diluted or retarded

by the addition of other substances). Substances which explode so readily as indicated are designated high explosives, and their effect is to shatter and destroy. It is obvious, therefore, that these are generally more useful for grenade work, where it is desired to shatter a grenade or to destroy obstacles. Propellants such as gunpowder and cordite may be used with good effect in certain grenades, but will be quite useless in others. As a general rule, it may be accepted that high explosives are the more suitable for grenades.

Gunpowder may be exploded by means of a time fuse only, but the high explosives require a detonator, and this should always be used in order to get the full effect and value of these explosives.

Gunpowder.

This is one of the oldest explosives known. It is a mechanical mixture of potassium nitrate, sulphur, and carbon. These substances are intimately incorporated by grinding and other operations. It is one of the best examples of a slow-burning explosive or propellant, and for hundreds of years was the only explosive used for ordnance. Its colour and appearance are familiar to all, but certain kinds of gunpowder look quite different from what we usually see in commercial life. The differences in appearance and colour are due to the various kinds of carbon (wood charcoal) used. Some samples of gunpowder are black, others slate or brown. The size of the grains varies from very small particles up to larger pieces, shaped prisms, or cubes. Powder is graded into various sizes, and designated accordingly.

The rate of explosion alters enormously, depending on the size of the grains, the finer the grain the faster the rate of explosion; prismatic powder being about the slowest.

The percentage composition of gunpowder varies considerably, but usually is—nitre, 75 per cent.; carbon. 15 per cent.; sulphur, 10 per cent.

For grenades, the fine-grain samples are the most suitable, but it is by no means an ideal explosive for such purpose.

Gunpowder deteriorates by damp. It is safe to handle in transport. It is unaffected by climatic conditions, very simple in use, compact, does not explode readily by percussion, and can be exploded by fuse alone. To get the best results, however, from gunpowder careful tamping is necessary.

Guncotton (Nitro Cellulose).

This explosive is extensively used in the Service, and complies with the conditions required, viz., safety in use and transport, stability under climatic conditions, and simplicity in use. It is fairly compact, and being a high explosive does not require tamping.

Guncotton is made by the action of a mixture of nitric and sulphuric acid on cellulose (*e.g.*, cotton wool). After the cellulose has been immersed in the acid, very little alteration is observable, but the action of the acids has converted it into one of the most important explosives known. Guncotton used in the Service is compressed into slabs weighing 15 oz. and measuring 6 inches x 3 inches x $1\frac{3}{8}$ inch. In this form it is usually kept wet. Every slab has a cylindrical hole in it measuring 1.3 inch in diameter. This is used for the insertion of a dry primer of guncotton. Wet guncotton is more powerfully explosive than dry cotton, but is very difficult to detonate.

Guncotton is also compressed into primers, which are kept dry, and are usually coated with paraffin wax. These cylindrical primers weigh 1 oz., and measure 1.25 inch high by 1.3 inch in diameter, and are provided with a conical perforation for the insertion of the Service detonator, which is used to detonate it. Dry guncotton will detonate wet guncotton, and to explode a slab of wet guncotton a dry primer is inserted in the hole provided for the purpose in each slab, and a detonator with fuse attached is inserted into the conical perforation of the primer.

Dry guncotton burns quietly in small quantities without explosion if ignited and unconfined, but large quantities may explode under similar conditions.

The products of combustion are different from the products formed on detonation.

Wet guncotton requires large quantities of high explosive to detonate it, so dry primers are always used for the purpose with the usual detonator attached. It is very safe, and does not deteriorate even after the lapse of many years if kept at moderate temperatures and away from sunlight.

Precautions.

Wet guncotton can be sawed, bored, or cut with safety. Always use wet tools and avoid dust, fluff, or grit of any description. Destroy all chips and dust. *Never cut or saw dry guncotton.*

NITRO-GLYCERINE AND DERIVATIVE EXPLOSIVES.

Nitro-glycerine is made by the action of a mixture of sulphuric and nitric acids on glycerine, in the same manner as cellulose or cotton is converted into nitro-cotton or guncotton Nitro-glycerine is a heavy oily liquid, its specific gravity 1.6. It varies in colour, some specimens being yellow or brownish-yellow. It has a very sweet taste, is poisonous, but odorless. It causes sickness and headache if introduced into the system. It explodes at a temperature of 360 degrees Fahr., or by shock or detonation. It burns if ignited. It is quite useless for grenades, and explosives containing nitro-glycerine mechanically mixed, as, for example, dynamite, &c., should be avoided.

There are many of the most useful explosives known which contain nitro-glycerine, for example, cordite, gelignite, &c., but in these cases the nitro-glycerine is so combined that segregation of the liquid is impossible. Nitro-glycerine is too dangerous to be used by itself.

DYNAMITE.

Dynamite No. 1 is a mixture of nitro-glycerine absorbed in an inert base, kieselguhr, which is an infusorial earth found principally in Germany and Scotland, and consists of shells of diatomaceæ, which are highly absorbent. Seventy-five per cent. of nitro-glycerine is absorbed by 25 per cent. kieselguhr. The

colour is buff to reddish-brown, and dynamite looks something like red putty. It is a very powerful explosive, but is much affected by low temperatures, which cause the nitro-glycerine to freeze, in which state it should not be used, and requires to be thawed, in doing which numerous frightful accidents have occurred. Under other conditions the nitro-glycerine is liable to separation. It is less powerful than guncotton.

Dynamite No. 2 is milder and slower than dynamite No. 1. It is black in colour, and consists of 18 per cent. nitro-glycerine and 82 per cent. of a rough gunpowder. Dynamites can be detonated easily with the usual commercial dynamite cap.

Blasting Gelatine.

This is one of the most powerful explosives known. It is composed of 93 to 95 per cent. of nitro-glycerine and 7 to 5 per cent. of nitro-cellulose (guncotton). It is 50 per cent. stronger than dynamite, and freezes at 40 degrees Fahr., when it becomes more sensitive. In this respect it is different from dynamite. It is a gelatinous mass, varying in viscosity and appearance. Some samples look like leather, others more like a thick glue. It is not affected by water, and can be kept in water. It is clean and safe. Like most modern explosives, it is made up into cartridges, which are wrapped up in special parchment paper with the contents, &c., clearly printed on the outside. It can be detonated by a Service or commercial cap.

Gelatine Dynamite.

This is a modification of blasting gelatine, and contains nitro-glycerine, nitro-cellulose, potassium nitrate, and woodmeal. It is a very useful explosive.

Gelignite.

This is another modification of blasting gelatine. It has similar ingredients and properties, but cheaper and more suitable for certain classes of mining work. It is also done up in cartridges similar to dynamite, &c.,

and is a suitable explosive for use in grenades. Its composition is 80 per cent. to 60 per cent. of nitro-glycerine, 8 per cent. of guncotton, 7 per cent. of wood-meal, and 20 per cent. of nitre.

Cordite.

Cordite is a well-known propellant used in the British and Japanese services with small arms and the largest guns. It varies in appearance, depending on the thickness of the cords or threads, in which form it is manufactured. It is a tough gelatinous substance, and its name is derived from the cord-like forms in which it is made. The thinner variety, as used in small arms, looks like a gut violin string, while the large sizes, used for big guns, look brown or yellow in colour. It is composed of 30 per cent. nitro-glycerine, 65 per cent. guncotton, and 5 per cent. mineral jelly, incorporated by means of a solvent such as acetone. This latter substance, however, is not one of the constituents of the final product. Cordite has proven it is one of the finest propellants in existence. Stable, safe, and easily handled, but being a propellant it is not an ideal substance for use in grenades. It can be used, however, but much better effects can be obtained from one of the shattering or high explosives.

Empire Powder.

Empire powder is another substance used, consisting of 84 per cent. guncotton, the balance being nitre and starch.

Ballistite.

Ballistite is a powder generally made in flakes of various sizes, and, except for a few technical movements, is similar to cordite.

Tonite.

Tonite—another high explosive—is formed by impregnating guncotton with one or more nitrates. It is supplied in cylinders 2 inches in diameter, of weights

¼ lb., ½ lb., and 1 lb., and in 5-lb. blocks measuring 5 inches cube. It is detonated with a large-size commercial cap, supplied by the manufacturers of the explosive. (M.E., 1910, Part IV., p. 90.)

Nitro-benzine Explosives.

Nitro-benzine, frequently used as an essence contained in oil of bitter almonds, is the basis of many important commercial explosives. These explosives are readily distinguished by the well-known odor. Nitro-benzine is an active poison.

Roburite.

This explosive is essentially a mixture of nitrate of ammonium with chlorinated di-nitro-benzine. It is a brownish-yellow powder, and is volatile without explosion. It burns in the open with difficulty. It is deliquescent, *i.e.*, it absorbs moisture from the atmosphere, and is therefore objectionable, as it is quite useless while wet.

Securite.

Securite consists of 26 parts of di-nitro-benzine and 74 per cent. of ammonium nitrate. It is a yellow powder, and is likewise deliquescent, and has the familiar odor of bitter almonds.

Bellite.

This is used in certain grenades at present. It is a similar compound to securite, and contains 20 per cent. of di-nitro-benzine and 80 per cent. nitrate of ammonium. This explosive is of Swedish origin.

Rackarock.

Rackarock is another of the di-nitro-benzine compounds. It consists of potassium chlorate, to which is added a quantity of di-nitro-benzine. Other hydrocarbons are frequently used for this purpose. It is

very safe, and a very popular explosive in certain districts. Detonation is carried out by means of a dynamite cap, &c.

Picric-acid Explosives.

Picric acid is extensively used as a high explosive. It has a bitter taste, and commercially is used as a dye, producing a most-brilliant yellow colour. It ignites with great difficulty, and burns with a very smoky flame. It is not usually considered an explosive, but some of the metallic solids which it forms are exceedingly explosive. In the crystalline powder in which it is usually found it can be detonated with difficulty. Its specific gravity is 1.6. Guncotton can be used to detonate it. Picric acid is made by the action of nitric acid on carbolic acid or phenol. If picric acid is fused and solidified, its explosive properties are enormously increased. It is then known as lyddite in the British Service, melinite in the French Service, while the Japanese call it Shimose powder.

It is interesting to note that certain gums or resins found in Australia and New Zealand are capable of producing large quantities of this compound. Germany has for many years purchased supplies of such gums ostensibly for the production of varnishes.

Tri-nitro-toluene (T.N.T.).

Toluene is a liquid hydro-carbon obtained with benzine from coal-tar and kindred substances. The action of nitric acid and sulphuric acid produces tri-nitro-toluene, *vide* similar reactions in the case of glycerine and cotton. This substance melts at 80 degrees Cent., is insoluble in water, and burns quietly if ignited. It can be easily detonated, however, by fulminate of mercury contained in our Service detonator, or by a commercial cap. It is capable of many modifications, and is known in the service as T.N.T., or trotyl. It is used by practically all the belligerents at present. It is a very cheap and very safe explosive, and exceedingly powerful. It varies in price from 1s. 2d. to 1s. 10d. per lb.

Amino Explosives.

Certain explosives with radical N.H.2 as the basis are known, and are used commercially.

Ammonal.

This is a compound which is used in certain grenades, as, for example, the "Pitcher," the composition of it being trotyl, or T.N.T., 31 per cent., ammonium nitrate 44.9 per cent., metallic aluminium 24.1 per cent. There are numerous other explosives which are being investigated and used, and which bid fair to surpass in good qualities many of those mentioned, trinitraniline, for example, but to try and describe these would probably be of little use to grenadiers, as one is then entering into technicalities too uninteresting for the average man.

Saxonite.

This is an explosive containing gelignite and ammonium oxalate.

Carbonite.

This substance contains nitro-glycerine, oakbark, nitre, and barium oxide.

Monobel.

This is another explosive used commercially, containing nitro-glycerine, woodmeal, and nitrate of ammonium.

Fulminates.

No description of explosives would be complete without a reference to the fulminates. They are most violent, dangerous, and delicate explosives, and are only used in the very smallest quantities in percussion caps, commercial and Service detonators. Mercury fulminate is most generally used. When wet, it is not explosive. It is made by dissolving mercury in nitric acid and

pouring this into alcohol, when the fulminate precipitates and falls to the bottom as a yellow sandy mass. It is then well washed and packed in calico bags holding from 10 to 20 lbs., which are always stored in water and transported in water. For use, it is dried on a steel plate, and this constitutes one of the most hazardous operations in the manufacture of explosives. For use in the detonators it is mixed with potassium chlorate, which increases its sensitiveness. The charging of the caps is done automatically by special and delicate machinery from a distance of about 30 feet, and the greatest possible care has to be exercised in the manufacture of these detonators, and also in the handling of them in the field. The slightest scratch, shock, or undue pressure may cause them to explode, and there is enough in an ordinary Service detonator to shatter a limb, if not to cause some more serious injury. Most of the explosives used commercially can be fairly safely handled, but in the case of the fulminates one cannot emphasize too often the danger of rough handling.

[Extract from *Military Engineering* (Part IV.), "Mining and Demolitions," 1910.]

APPENDIX 1.

Tests for Explosives.

1. Dynamite, blasting gelatine, and gelatine dynamite should be tested as laid down in "Regulations for Army Ordnance Services, paragraphs 388-396.

2. Test for bellite, securite, roburite, and other explosives containing ammonium nitrate.—The danger with these explosives lies in their getting damp and failing to explode. A few cartridges should be detonated in the open to see that they are serviceable.

Test for sensitiveness of chlorate explosives.—Place a small quantity of the explosive on a stone or wood floor and give it a glancing blow with the end of a common broomstick held lance-wise. If the sample will explode easily on a stone floor, it should not be used for charging boreholes, and if it will explode on a deal floor it should be used with care. This test is only applicable to explosives containing chlorates.

SECTION 12.

ORGANIZATION OF GRENADIERS.

This appears, at present, to be subject to change from time to time, and no well-defined organization seems to exist.

Circular memorandum 454, page 14, states the number to be trained in each Light Horse regiment, Infantry battalion, &c., but, in addition to the numbers laid down there, the following is additional:—"It is not intended to limit the number of men who should have some knowledge of grenades generally." From information received, about 25 per cent. of each battalion is being organized into grenadiers at the present time, but there are indications that this number will be greatly increased in the near future.

The *personnel* selected as grenadiers should be, first of all, good soldiers, should have completed their musketry course, &c. They should be plucky, but not clumsy, brave and steady in emergency, and selected from the very best men available. In each battalion there ought to be a definite number of experts who can teach and hand on information of any fresh facts which may arise periodically. A party of from ten to fifteen appears to be the most suitable unit, but this will vary according to the local circumstances and conditions, and must be altered when necessary to suit the task in hand.

The instructions issued by the Imperial General Staff, Section 1, will be taken as the standard, but for information, some notes compiled from memorandum from the G.O.C. 19th Infantry Brigade are attached here for guidance, also some notes on bomb fighting at Gallipoli by Captain D. W. Edwards are attached for information. Until further instructions are issued the training and organization as set forth by the Imperial General Staff will be followed by all concerned as being the latest standard information on the subject.

Hand Grenades in Trench Warfare.

The following notes, compiled from a circular memorandum by G.O.C. 19th Infantry Brigade, are produced for guidance:—

In the attack it is doubtful if hand grenades would be of much use till the first trenches are captured. If held up, *e.g.*, by wires, near the hostile trenches, it is possible that a hand-grenade party might be of use to pitch grenades into the enemy's trenches, but it is unlikely that grenades would be up at that period of the action.

The time when they will be of most use in attack on opposing trenches will be when the front trenches are gained. Hand grenades should then be sent up each of the communication trenches and along the fire trench. In either case the best position to take up would be in the trench behind a traverse or bend, from which cover grenades would be thrown at any of the enemy approaching.

2. To organize a grenade party, the following is suggested:—

Squad to consist of two men (with rifles and bayonets), two men for throwing (rifles slung), and two men to carry basket of grenades (trained as throwers to replace casualties), and one N.C.O. in charge of squad.

3. The party would move off up the trench in the following order:—

Man with rifle and bayonet ready for use.
Bomb-throwers with grenades.
Carrier with basket of grenades.
N.C.O.
Second thrower.
Second carrier.
Spare man.

As soon as the first basket of grenades is finished, it should be passed back for a further supply, and the full basket of the second carrier passed to the No. 1 carrier.

4. The grenade squad should act on the offensive, bombing the enemy wherever found, and then pressing on to bomb the next section between traverses; for if they remain stationary when the enemy is approaching they will be located, and probably themselves bombed.

5. When an enemy's fire trench has been captured, it will be necessary to make a second advance, usually from the communication trenches, after which the next trench will have to be tackled, the bombing squad being split in two and turned outwards, so as to avoid being taken in the rear.

6. In the defence, grenade squads are probably best in the support trenches, ready to advance up communication trenches to meet the enemy should he take the fire trench and try to advance.

BOMB FIGHTING AND METHOD OF TRAINING, BY CAPTAIN D. W. EDWARDS, 7TH BATTALION, A.I.F.

Trench Fighting.

When two opposing forces are entrenched in close proximity with each other, bombing is resorted to for the purpose of destroying his works and keeping him in subjection; to do this sucessfully two definite types of bombs are used, one to exterminate the enemy, the other (the heavy type) to destroy overhead covers and parapets.

Bombs manufactured and used in Gallipoli:—

Type A, for use against individuals, has three classes, viz.:—

Class I.—Jam-tin bomb.
II.—Cricket-ball bomb.
III.—Matchhead bomb.

Type B, for demolition of works and overhead cover:—

Class I.—Lotbiniere bomb.
II.—Trench mortar bombs.

Type A.

Class I.—It was found necessary to manufacture bombs at Anzac and to overhaul bombs of a faulty character made in Egypt. We could make a very effective bomb from 1-lb. jam tins and other tins of the same size, called the jam-tin bomb. This bomb had three compartments—the inside chamber, about an inch in diameter, contained the charge; the second chamber, 2 inches in diameter, filled with broken resin; the third, or outside chamber, filled with broken pieces of shell hammered smaller on anvils at the bomb depôt.

Class II.—The standard type of Class A bomb is called the cricket-ball bomb; of these, there are three or four known kinds. These bombs are constructed of cast iron, and are about ½ inch thick and 3½ inches in diameter; they have various attachments for lighting the fuse, the one most used and looked for is the plain type, the fuse of which the bomber places the end against a smouldering piece of bag rolled round a stick, placed so that it is easily got at when the bomb requires lighting. All bomb fuses have been stardardized, that is, a five-second fuse, bombs having fuses of incorrect length are returned to depôt and fused afresh.

Class III.—The matchhead bomb has the same peculiarities as the cricket-ball bomb, the difference in the fuse having a head like a safety match, which, after the copper protector being removed, would light readily when rubbed on a brassard or any other friction surface. The concussion from these bombs being very strong, and the radius of effect in a trench 3 feet wide is about 6 feet.

Type B (Heavy Bomb).

Class I.—The Lotbiniere bomb (or cricket-bat bomb) is used when a shattering effect is required. A piece of guncotton 8 x 4 x 2 is strapped to a piece of wood shaped with a handle like a small cricket bat. The ends of the guncotton kept firm by two pieces of wood fastened at the top and bottom of the bat. A hole for

the detonator is in the centre of slab, and this is connected to a five-second fuse. These bombs are used against overhead cover, built so as to give the enemy bombers a place of security after they had thrown a bomb of type A.

It was found that two of type B bombs, Class I., thrown at one spot had a very great effect and loosened all cover and parapets in the vicinity of explosion, but not so much as to cause damage to our own works.

Class II.—Trench mortar bombs are used against the enemy's works and trenches. They are situated from 100 to 300 yards from the enemy's trench. This type was largely used by the Turks against our positions in Lone Pine, and had serious effects when well aimed and struck the parapet.

Training of Bombers.

It is essential that every man should be conversant with both types of bombs, and trained that he can quickly obtain superiority over his opponent by bombing, the same as rifle fire; this must be obtained, otherwise loss of life occurs in the trenches, and men easily become demoralized owing to the developing of a heavy fire by opposing bombers, who, having gained a temporary advantage, will advance until they can look into the trenches, and thus cause heavy casualties. The Turk is a very daring bomber, and will creep up to our own works just to throw one bomb.

Method of Training.

Bombers, then, should aim at personal superiority, combined with resource and energy.

When a soldier in the trenches proves a very accurate bomber he is given a responsible post, where he can enfilade a section of the enemy's trench.

It was found necessary to instruct men in bombing after they had landed on the Peninsula, as this training was not carried out in Australia or Egypt.

Men upon arrival were allotted to units in the Reinforcement Training Camp, 1st Division, and there had to pass tests in bombing, bayonet fighting, and rifle fire,

so that they could work efficiently with the more experienced soldiers when allotted to units serving in the trenches.

Training is carried out as follows:—

1st Stage.—Throwing jam tins filled with old pieces of shell, the weight being about the average weight of a bomb of Class A. The men are taught to throw straight, and later to increase their length of throw.

2nd Stage.—Men taught to throw dummies into a small trench, 2 feet long, 4 feet wide, 1 foot deep; distance, 20 yards; later this distance is increased to 25 yards, then to 30 yards, this being the limit of effective range of bombers.

3rd Stage.—Men taught to throw from a trench 4 feet deep into another trench 15 to 20 yards away, and to attack each section as ordered.

4th Stage.—Men taught to light fuses of dummy bombs in trench before attacking named sector, combined with holding bomb while fuse is burning, in order that desired effect may be obtained; that is, high explosion on parapet, explosion in trench, or explosion on bottom of trench.

Bombs are held, according to the distance between trenches, about one second, 20 yards; two seconds, 15 yards; two and a half seconds, 10 yards; bomb exploding just inside parapet of enemy trench.

5th Stage.—Men taught use of periscope as observers of bomb fire, explaining to bomber where target is, and watching for results.

6th Stage.—Bombers work in pairs, the observer locates target, the bomber throws the bomb, crouched up against post in left-hand corner, observer in the right, or otherwise; results watched for through periscope; both bomber and observer under cover.

Principles governing bombing in trenches:—

1st.—It must be understood that at night both bombers take position in post, and expose themselves (head and shoulders), watching for positions from whence enemy bombs are coming, when they will at once endeavour to bomb him out.

2nd.—It was found necessary to use two bombs to the enemy's one in order to silence him, this having the desired effect of conserving the bomb supply, besides gaining individual superiority.

3rd.—Reserve of bombs in first-line trenches kept as low as possible, consistent with tactical situation and the knowledge gained of the enemy's future movements from prisoners, patrols, or air craft; this being necessary as a safeguard against the enemy becoming possessed of a good supply of bombs in the event of him taking the trenches occupied by our forces.

4th.—All heavy bombs—Class B—are kept at battalion head-quarters, and only four allowed to be in a trench at one period, conditions being normal; only experienced bombers or officers are allowed to use Class B bombs, as they are only required against particular objectives and require careful handling.

5th.—All enemy bombs which fall unexploded into trenches are collected and taken by N.C.O. to battalion head-quarters, they are then sent to the depôt, where they are overhauled, and re-fused, and issued for use. (This procedure was found necessary owing to accidents caused by enemy throwing bombs with an instantaneous fuse, which killed the bomber who *lit it*.) In the excitement, a bomber is apt to forget the time of fuse attachment to enemy bomb, or not make correct allowance when throwing, thus causing inaccurate fire.

6th.—To get required result it is necessary to time each bomb correctly *before* throwing, this is done by tapping bomb with the forefinger, counting 1—2—3 before throwing, the count falling on every second beat of finger. This was found to be the most accurate and easy method of timing each throw.

7th.—Men should not be taught in larger bodies than eight or ten when instructing in the first or second stage.

8th.—Lectures should be given on different types of bombs and their component parts, thus making men familiar with bombs and increasing their interest in this type of fighting.

9th.—Reliefs when resting in recesses in firing line are safeguarded from bomb fire by overhead cover, and two men on duty, called blanket men, stationed one at each end of overhead cover, whose work it is, immediately a bomb reaches the bottom of trench, to cover it with blanket or old overcoat, to smother the effect of explosion. This method is very effective, as no fragment of bomb escapes.

SECTION 13.

MORTARS, SPRING GUNS, AND CATAPULT.

The above are used to throw bombs, and have the advantage that they can project these missiles at a greater distance than is possible by hand. Any hand grenades or bombs may be thrown by these machines, but the larger the size the shorter the range. These in struments are generally rather bulky, and require very deep and comparatively wide trenches. Special trenches require to be made to use these weapons. Such trenches are usually placed in rear of the foremost firing line and to a flank of a communication trench. Although it seems a revision of the most primitive methods of projection, there are certain advantages to be gained by such simple contrivances. The noise is small compared with a gun or mortar, and for that reason, therefore, a certain amount of secrecy is obtainable, which in itself is a considerable protection. There is no smoke, no flash, and nothing is visible from the surface to indicate the position of these weapons, and they could be easily screened from view from aeroplanes, their comparatively small size making it practically impossible for them to be obscrved except at night, when the fuse may disclose their position.

Trench Catapult.

This machine is simply an enlarged shanghai, the propelling force being due to rubber bands put in tension by means of a rack-and-pinion gear, three to one, and piece of steel wire rope, about the thickness of an ordinary clothes line, attached to a pocket which holds the grenade or bomb. The attachment to the pocket is composed of a clip or hook with a releasing arrangement which acts as a trigger.

The range of this weapon is determined by the tension exerted on the rubber bands. A rough scale is provided on the centre beam of the catapult, marked off only as a guide. The elevation is arranged for by means of a small clinometer of very simple design placed on the side of the central beam or bar.

The simplicity of this apparatus makes it difficult to describe, but reference to Plate XXI. will show how primitive and simple the whole arrangement is.

The framework of the catapult is made of wood suitably screwed and bolted together, and it is 12 feet overall. The rubber bands consist of ½-in. circular rubber of the best quality, six or more in each bundle, there being two bundles, one on either side of the pocket. The pocket for holding the grenade is made of canvas, with a rope top. The rubber bands are secured to the catapult by means of cord, and the pocket is secured to the rubber bands also by cord. The steel wire attached to the gear box passes over a pulley at the tail end of the catapult, and is brought back to a brass gear box with two pinions and an ordinary crank handle, the gear being, as already stated, three to one.

The catapult in use is elevated to the required elevation, and is held in position by means of sandbags, or may be anchored by means of rope attached to a couple of screw-eyes provided for the purpose.

These catapults weight about 50 lbs., and cost something about £12 a piece. They are fairly accurate, and it is easy, with practice, to lob two out of three grenades in a 3-ft. trench at 120 yards distance.

The fuses used on the bombs have to be made variable to suit the respective distances. It is stated that the pressure that can be got up with this machine reaches 900 lbs. The machine is graduated up to 150 yards, but the figures act as a guide only. A range of 150 yards may be attained.

WEST SPRING GUN.

This gun is used for projecting bombs from trenches, and, as the name indicates, springs are used to propel the grenade. The action of the gun is very simple, and a reference to the sketch will make the general arrangement clear. Moving about in axis, a double lever with

unequal arms 3½ inches and 2 ft. 6 in. is arranged. To the short end of these levers is attached a set of 24 spiral steel springs, each 15 inches in length, the longer end of the lever, which is made of wood, is provided with a carrier platform to suit various shaped bombs. This double lever is suitably arranged on two vertical triangular iron frames flanged and bolted to wooden base, which supports the whole machine. A lever 5 ft. 9 in. effective length, of unusual shape, made in two pieces (shown in dotted lines in the diagram, Plate XXIII.), is used to set the gun into firing position, this lever is removed when firing. The strength of the springs is very great, requiring the united efforts of two men to bring the gun into firing position. A locking piece attached to a long horizontal tubular lever 4 ft. 4 in. long holds the gun in tension. The weight of this lever is compensated for by spiral springs, not shown in the diagram. The locking piece is screwed and adjustable, and is provided with a rough graduated scale for distance, graduations being from 50 to 100. The greater the distance the greater must be the tension on the spring, and this adjustment is got by a locknut, which alters the vertical height of the locking piece.

A small radial motion is allowed for traverse, and a deflection scale is fitted on the base and marked off into 4½ degrees. Four iron tubes on the wooden base act as suitable handles for moving the machine about. The extreme range of this gun is about 200 yards. The machine weighs approximately 2 cwt., and, although larger and heavier than the catapult already described, it has proven a very effective, though rather clumsy, weapon. It has the advantage of silence, and its position will therefore not be readily located. Alongside the gun, however, the noise appears to be rather great compared with the catapult, but it is inaudible at a few yards distance.

A very deep and wide trench is necessary to use this machine; it is usefully employed in large numbers on the Western Front at present.

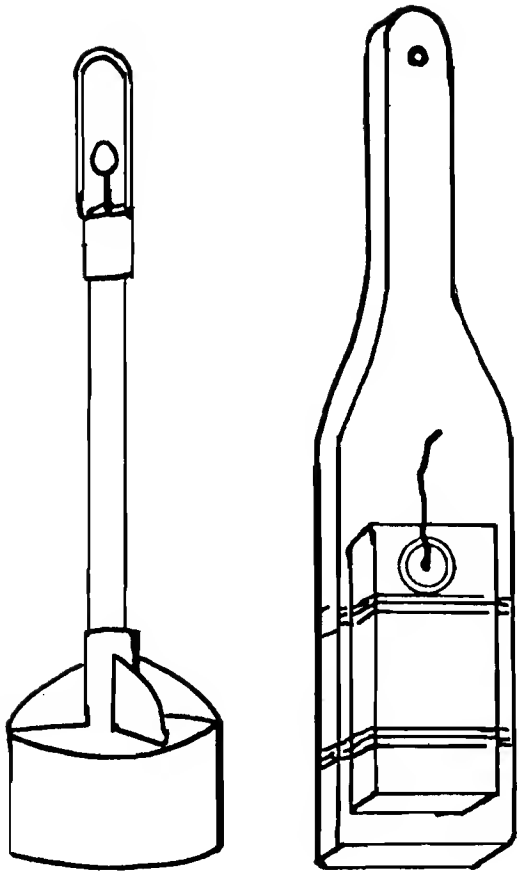
The machine is fired by pressing the long horizontal lever. The total length of the machine is 6 ft. 6 in., width 1 ft. 7 in., and height 7 feet.

STOKES GUN.

This is a gun for use by infantry, and is of the simplest possible design, consisting of a steel tube 2 or 3 inches in bore, the former being used to fire a 24-lb. shell, while the latter is used to fire a 15-lb. shell. The range is stated to be 300 to 350 yards and in expert hands 24 rounds per minute can be fired. The gun is muzzle loading, and at the end of the bore is provided with a fixed striking pin. The shells used have a similar lighting mechanism to the Mills hand grenade, *i.e.*, they automatically ignite after leaving the bore of the gun, the side lever being held in position while the projectile or bomb is in the bore. The propellant charge is attached to, and forms part of, the shell itself, and it is provided with the usual percussion cap. On placing a shell into the gun, which is smooth bored, the shell drops rather violently on to the striking pin, which forms part of the gun itself. This detonates the small propellant charge attached to the shell. It will be seen, therefore, that the gun is capable of firing as rapidly as the *personnel* are capable of loading.

A simple clinometer is provided for elevation, while the traversing is effected by moving the base of the gun over a dial plate provided with holes, in which a pin attached to the gun fits. It will be noted that the arrangements of this gun are simple in the extreme, and this is borne out also by the fact that they cost from £8 to £12 each.

Of all the means used for projecting bombs, the principles of this simple contrivance strike one most favorably. The writer has not seen the gun itself, but appreciates the simplicity and excellence of the principles involved. A rough diagrammatic sketch showing the ideas embodied is given in Plate No. XXIV.

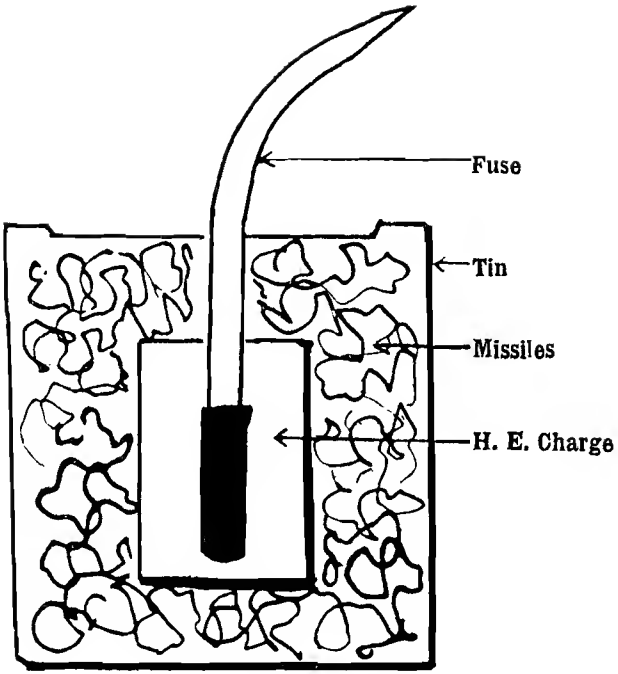


1 2

1. Russian Hand Grenade.
Class II.
Ignites by pulling small ring in end of the handle.

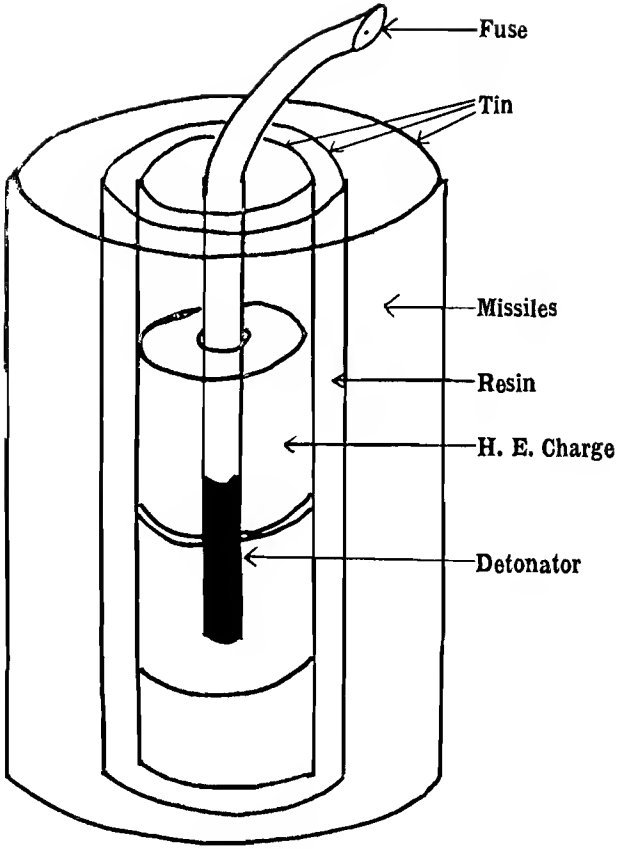
2. "Cricket Bat" or "Brush Back" Grenade.
Handle wood, high explosive charge attached,
"Lotbiniere" Bomb.

PLATE I.



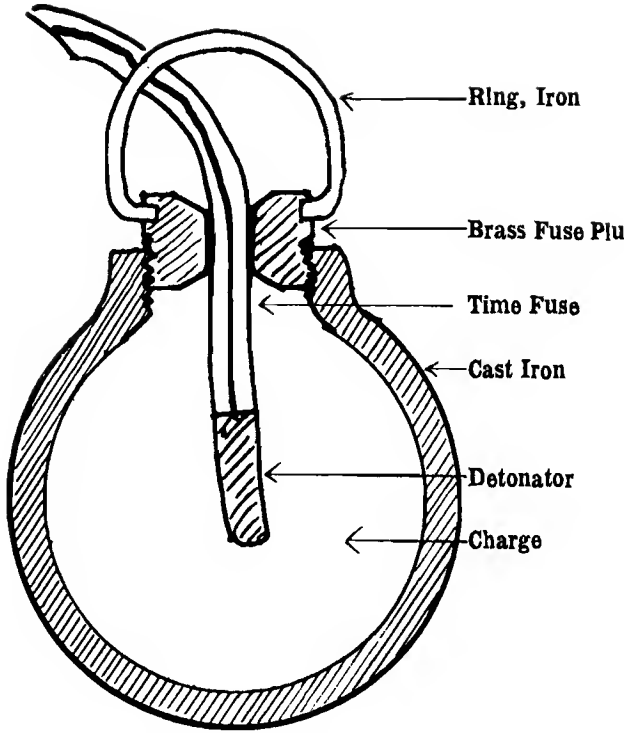
Simple Jam-Tin Grenade.

PLATE II.



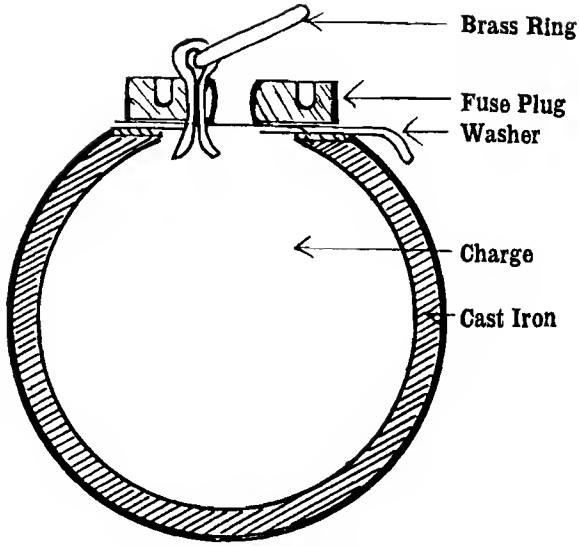
JAM-TIN GRENADES.

PLATE III.



TURKISH GALLIPOLI GRENADE.
Wt., 1 lb. 6 oz. Dia., 2⅞ in.

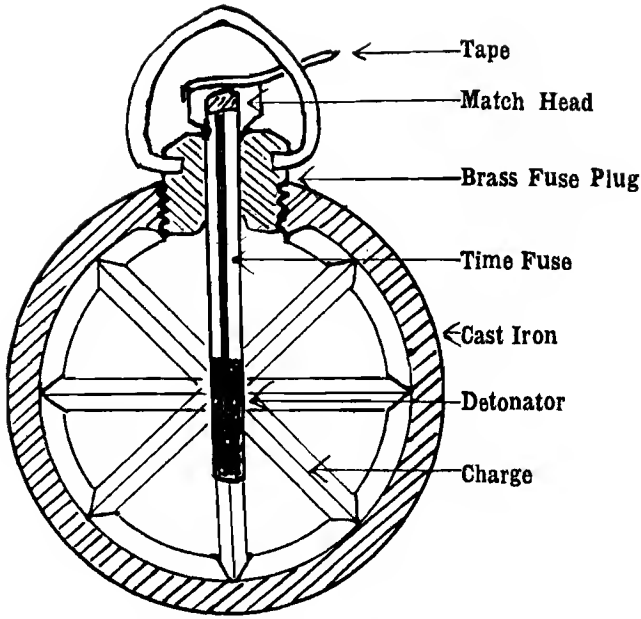
PLATE IV.



British Hand Grenade.
Wt., 1 lb. 11 oz. Dia., 3 in.

"Cricket Ball" tvpe. There are many variations in design of Fuse Plug.

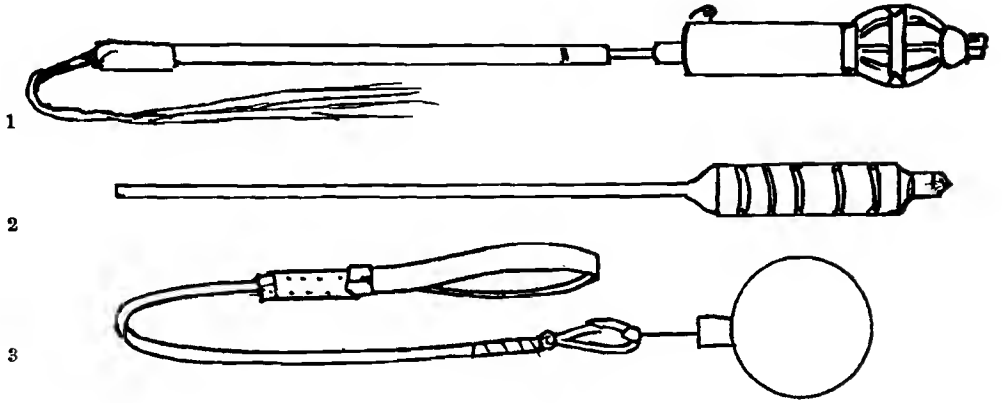
PLATE V.



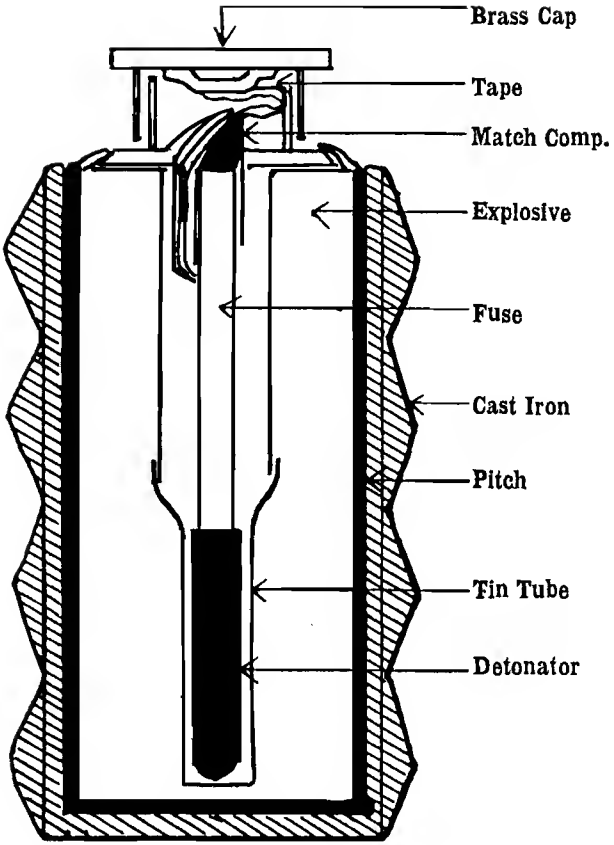
AUSTRALIAN "LAW-ADAMS" GRENADE,
Wt., 1lb. 4oz.; dia., $2\frac{3}{4}$ in.
Note internal segmentation and "Brock" Lighter.

PLATE VI.

PLATE VII.

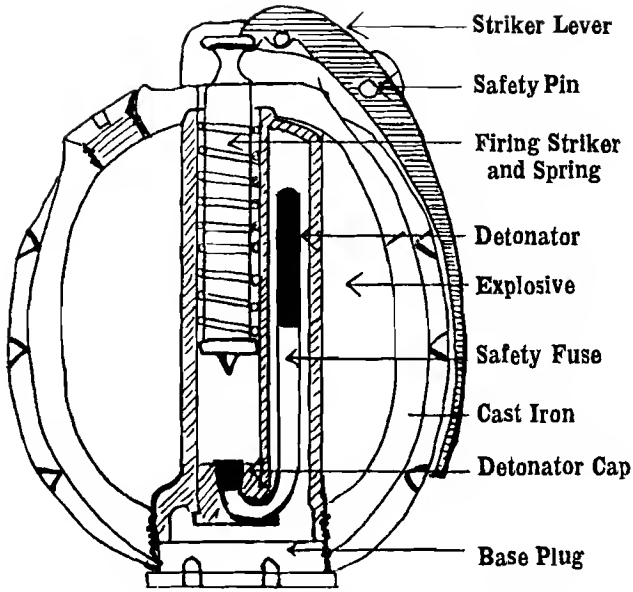


No. 1. Hand Grenade, Class III.
2. Rifle Grenade, Class III.
3. Hand Grenade, with Throwing Strap, Class II.



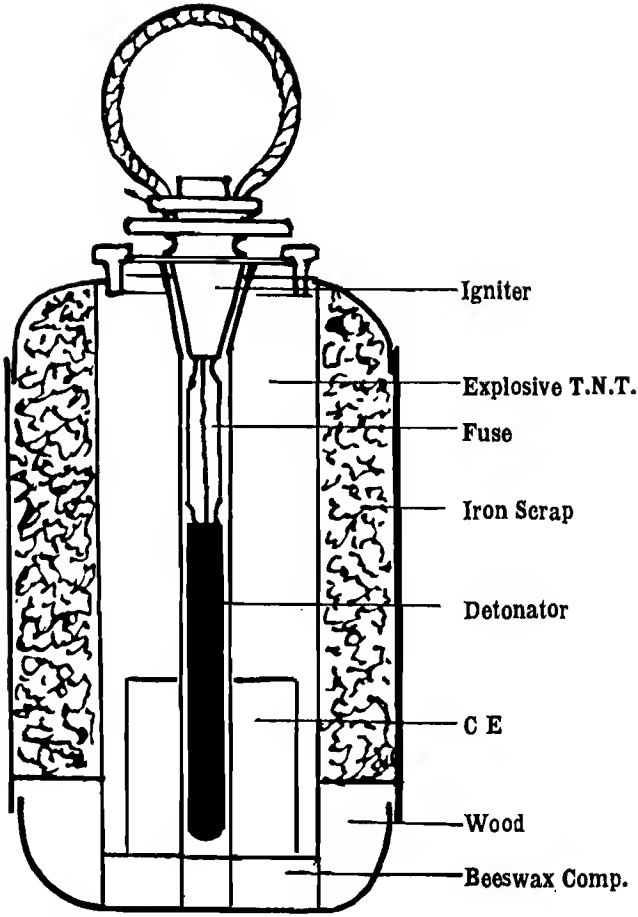
PITCHER HAND GRENADE.

PLATE VIII.



"MILLS" HAND GRENADE.
GRENADE, HAND, NO. 5, MK. I.

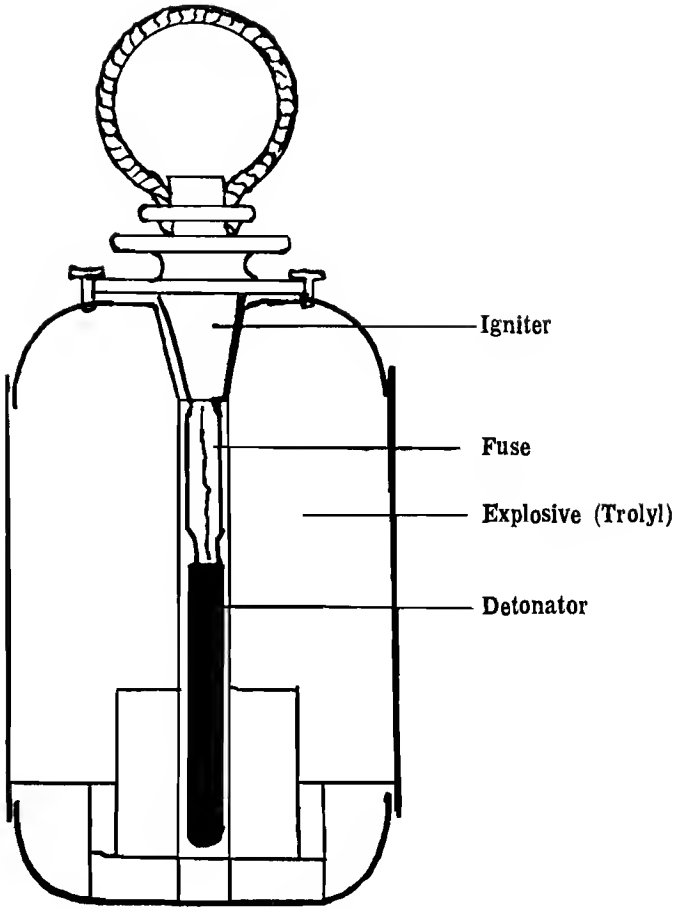
PLATE IX.



HEAVY.

HAND GRENADE NO. 6 AND 7, MK. I, BRITISH.

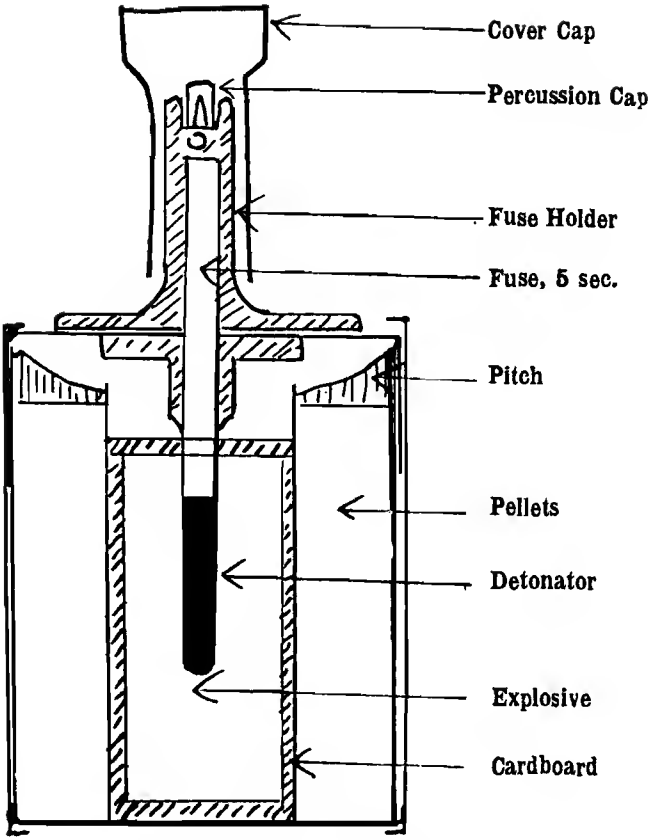
PLATE X.



LIGHT.

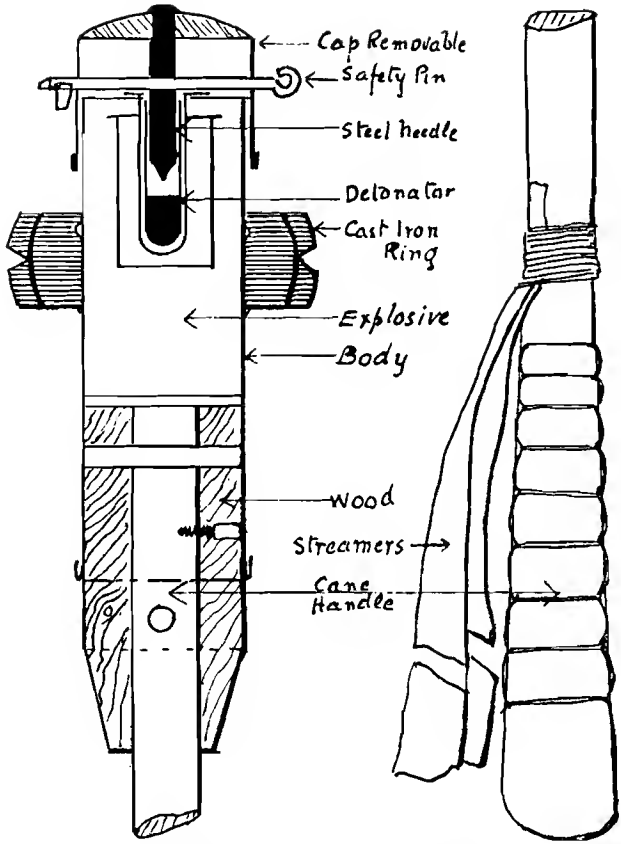
HAND GRENADE, NO. 6 AND 7, MK. I, BRITISH.

PLATE XI.



"WELSH-BERRY" GRENADE.
(Australian).

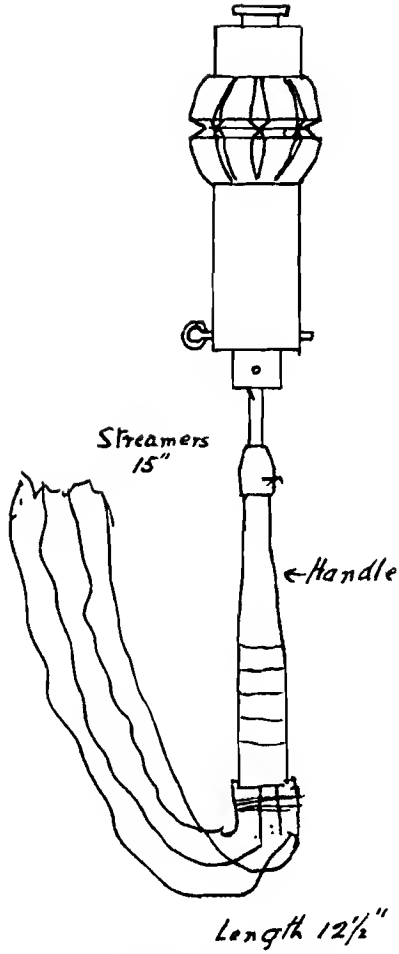
PLATE XII.



GRENADE—HAND, NO. 1, MK. I.

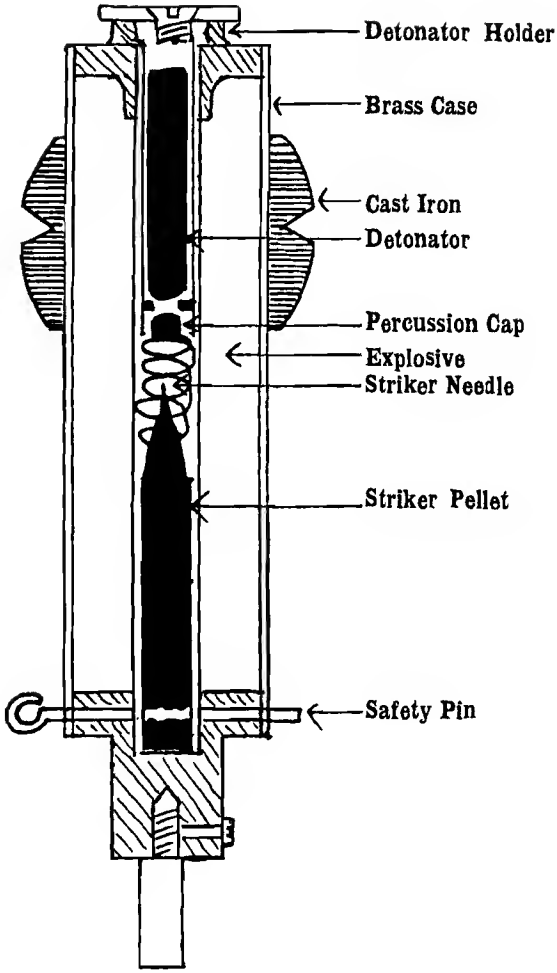
(British.)

PLATE XIII.



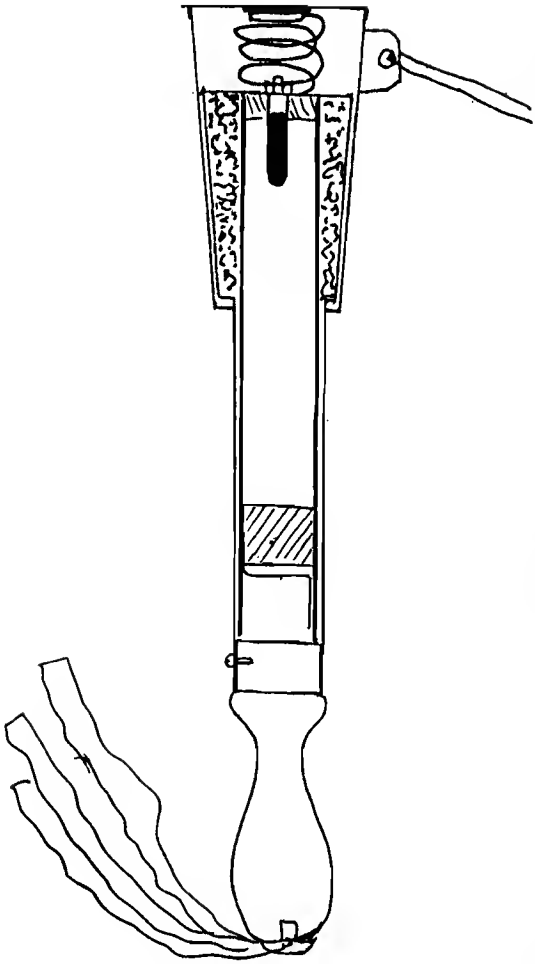
"HALES" HAND GRENADE.
(The Mexican.)

PLATE XIV.



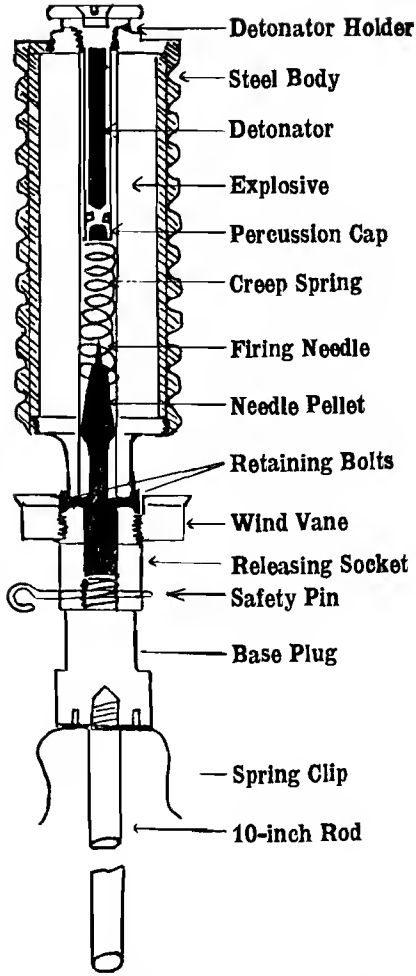
"Hales" Hand Grenade.
(The Mexican.)

PLATE XV.



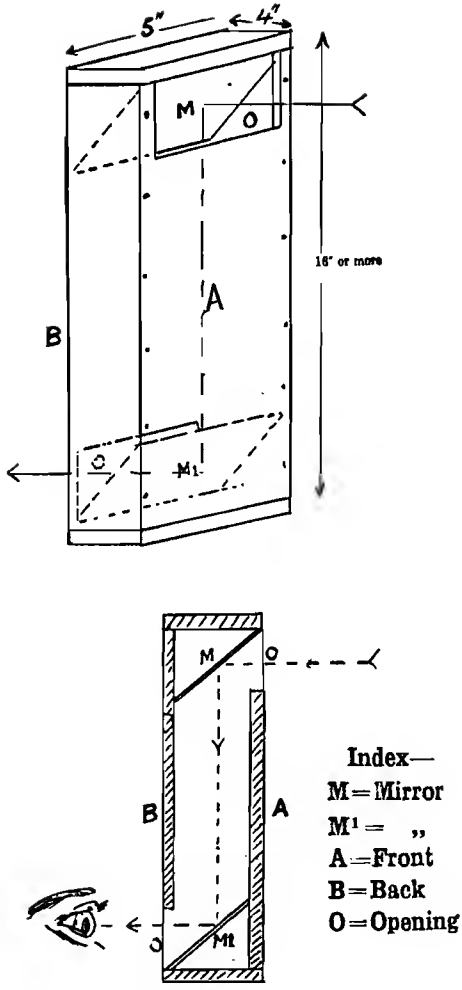
AUSTRALIAN HAND GRENADE, CLASS III.

PLATE XVI.



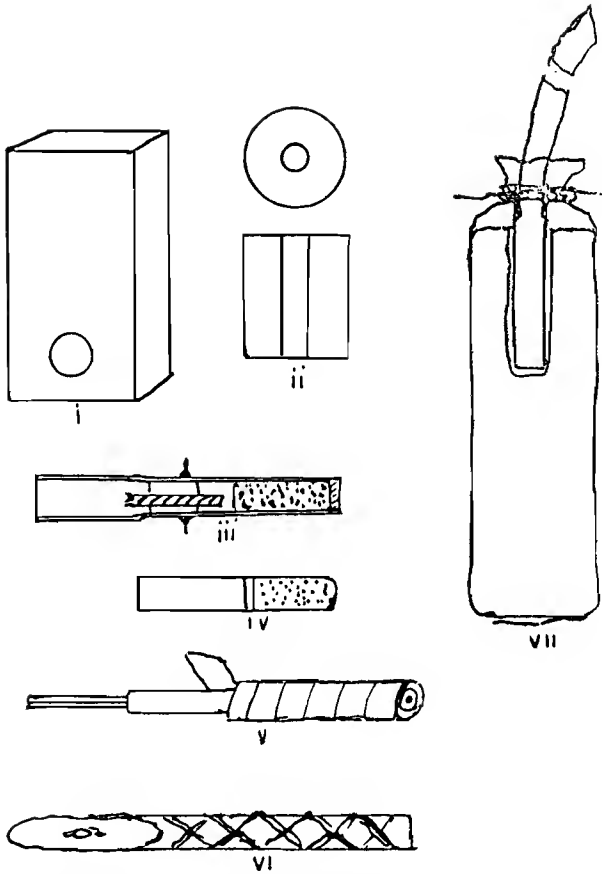
GRENADE, ·303 SHORT RIFLE, NO. 3, MK. I., J PATTERN.

PLATE XVII.



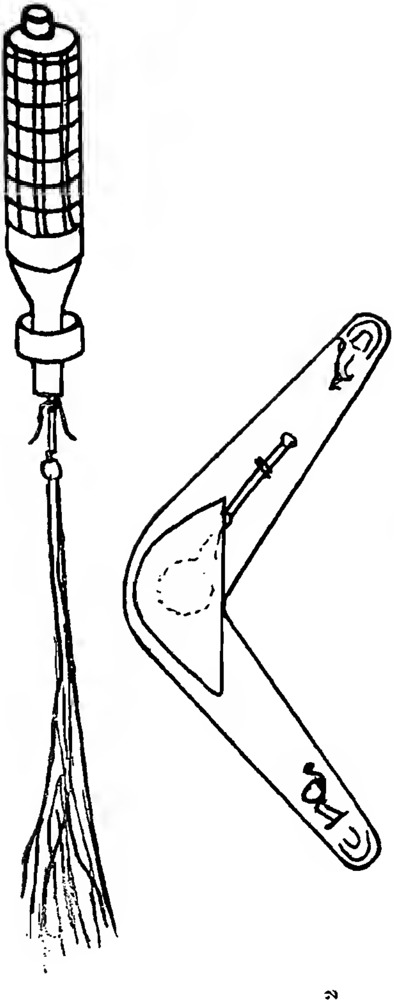
SIMPLE TRENCH PERISCOPE.

PLATE XVIII.



i. Slab of Guncotton, 6 x 3 x $1\frac{3}{8}$, 15 oz.
ii. Primer of Guncotton, 1·25 x 1·25 dia., 1 oz.
iii. Detonator (No. 8, Mk. IV.).
iv. Commercial Cap.
v. Safety Fuse (Black.)
vi. Instantaneous Fuse (Orange).
vii. Gelignite with Detonator and Fuse.

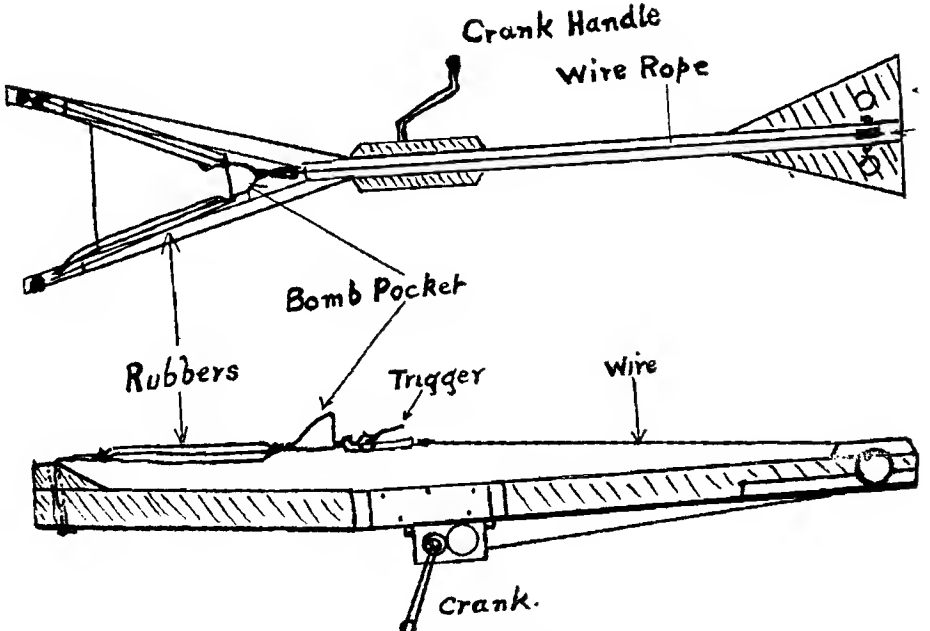
PLATE XIX.



1. Hand Grenade with streamers.
2. "Russell" Boomerang Grenade.

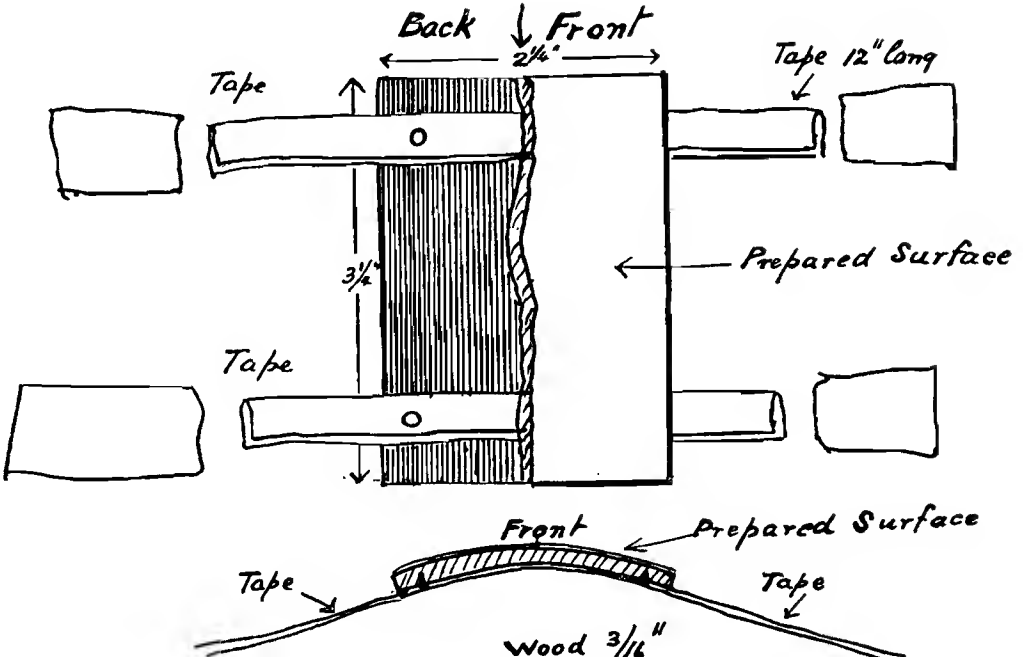
PLATE XX.

PLATE XXI.

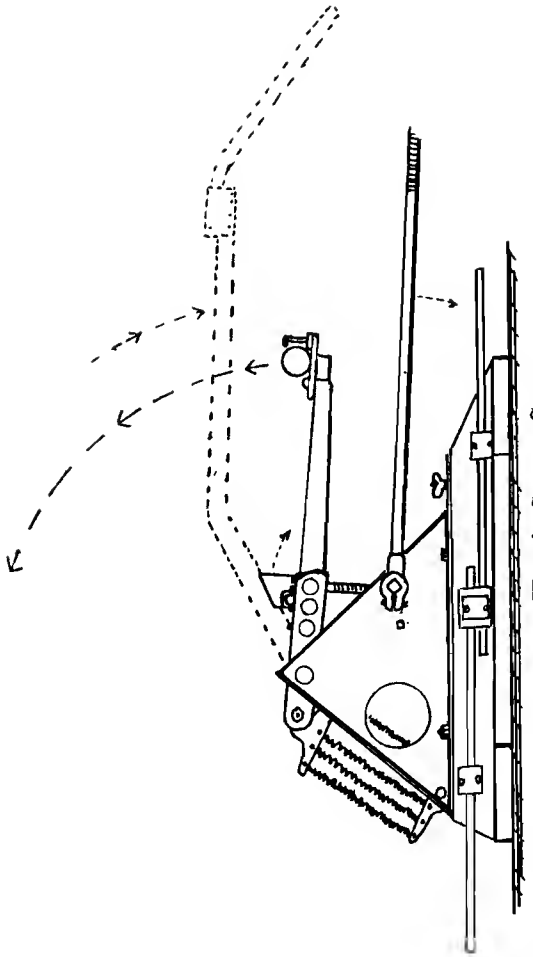


TRENCH CATAPULT.
Weight 501bs., length 12 feet.

PLATE XXII.



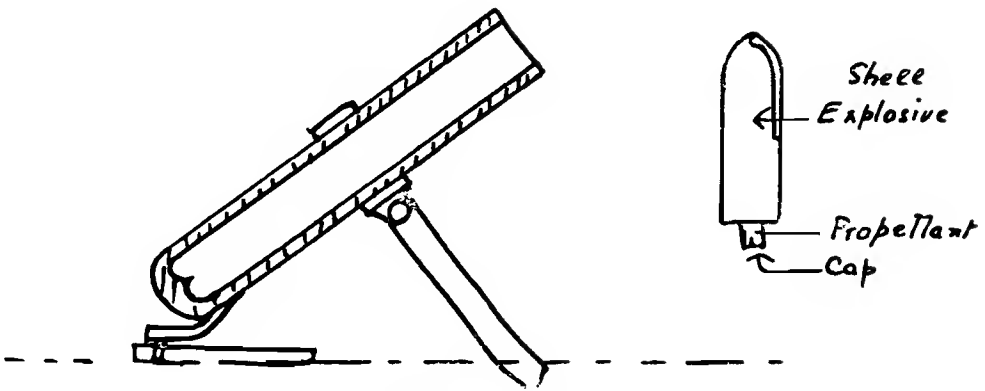
BRASSARD.



West's Spring Gun.

PLATE XXIII.

PLATE XXIV.



STOKES GUN.